

ZIRN - Interdisciplinary
research unit on
risk governance and
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University of Stuttgart
Institute for
social sciences
dep. for environmental
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DIALOGIK
non-profit institute for
communication and
cooperation research

Stuttgart contributions to risk and sustainability research

Communicating chemical risks

**The role of risk perception and communication
for characterizing and managing
cumulative stressors**

Christina Benighaus and Ortwin Renn (Ed.)

No. 10 / March 2008

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Workshop report

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Preface

By Christina Benighaus and Ortwin Renn

This booklet is the summary report of the Open Workshop “*Communicating chemical risks*” which took place on 12-13 of April 2007 in the International Meeting Centre of the University (IBZ) in Stuttgart, Germany. This Workshop was one of a sequence of workshops which highlight the different issues of the EU-project NoMiracle. The integrated EU-project NoMiracle will develop novel methods and tools to better evaluate chemical risks. It will help increase knowledge on the transfer of pollutants between different environmental compartments, and on the impact of cumulative stressors, including chemical mixtures. Please have a look at the homepage of the project: <http://nomiracle.jrc.it>.

Each Research Pillar of the NoMiracle-project will organize one Open Workshop to discuss their special issues of the Pillar and transfer them to a wider circle of experts. In Pillar 4 of the project DIALOGIK conducted an extra workshop especially focussing on “Communicating chemical risks” which is one task of the workpackage 4.3. The integrated EU-Project NoMiracle is funded by the Commission within the 6th Framework Programme for Research and Development within the Thematic Priority “Global change and Ecosystems” under the Contract No. 003956, coordinated by Dr. Hans Løkke at NERI, DK-8600 Silkeborg, Denmark.

The workshop was the subject of the NoMiracle Newsletter n° 9 (September 2007) in which short versions of some of the following articles can be read.

Online:

http://nomiracle.jrc.it/Newsletters/NoMiracle_Newsletter_no_9.pdf

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We would like to thank our colleagues in the NoMiracle Project Timo Assmuth and Mikael Hilden at SYKE and Hans Løkke at NERI for valuable comments on the drafts of the programme. Also many thanks to Marion Dreyer at DIALOGIK, Timo Assmuth, Mikael Hilden at SYKE, Hans Løkke at NERI, Staffan Skerfving at Lund University, Peter Wiedemann at Forschungszentrum Jülich and David Wright from Trilateral Research & Consulting (UK) who all presented their knowledge in talks and summaries for this report. We had also invited Jürg Oliver Straub from F. Hoffmann-La Roche Ltd. Basel, Peter van den Hazel from the Public Health Service Gelderland Midden Netherlands (both of them NoMiracle Advisory Board members), Herbert F. Bender from BASF AG, and Filipp Cnudde from Wageningen University (SAFE FOODS IP) as participants for the two panel discussions in the workshop. We are deeply grateful for their contribution. Without our three students Regina Schröter, Michael Seyfried and Anne Koslowski the whole organisation of the workshop would not have been possible without them. We appreciate the valuable proofreading of our colleague Julia Ortleb. We thank Claire Mays at Institut SYMLOG de France for her valuable comments while reviewing this documentation. It was also a great pleasure to work with the 50 participants who were very ambitious discussing solutions and different ways for Risk communication during the two days. The friends of the University of Stuttgart funded parts of the costs of the workshop. Many thanks for this support. And last but not least we want to thank Ludger Benighaus and the two little kids Marvin and Nils who gave the event a lively touch.

1 Open Workshop in Stuttgart

By Christina Benighaus

1.1 Frame and goals

Communicating about chemicals is a challenging task for risk managers in companies and regulatory authorities. This workshop focused on good practice in risk communication and *“How we could do better?”* Various case studies examining the perception and management of risks, from the chemical as well as from other sectors, gave insights of the wide range of how risks could be handled and communicated.

1.2 Goals and main questions

The workshop wanted to explain and discuss the perception and communication of chemical risks, especially cumulative stressors for enhancing risk analysis and management within the NoMiracle project. Therefore it demonstrated the theoretical, practical and instrumental role of perception and communication within the risk governance cycle. It addressed complexity, uncertainty and ambiguity in the NoMiracle context and gave ideas how to communicate NoMiracle methods as improved tools for assessing complex risks, and for providing more safe assessment of risks in a world of complexity.

The following subjects were part of the workshop

- Complexity, uncertainty and ambiguity in risk assessment and management
- Major Insights from risk perception studies and their relevance for regulating cumulative stressors
- Aspects of risk governance: an integrative perspective of risk
- The role of assessment and perception for risk management
- The crucial function of risk communication at all stages of the risk governance process
- Models of stakeholder involvement and participation
- Experience, toolkits and good practices from other EU-projects related to risks

The workshop also tried to develop communication insights for different audiences such as industry, politics, scientists and risk regulators and to create a foundation for the natural science colleagues to understand and comprehend the social science part of the NoMiracle project.

1.3 Target group

The workshop invited a broad audience of stakeholders from companies, NGOs, regulation, EU-representatives, academia, especially young researchers and Ph.D. students from different disciplines and project partners from similar EU-projects. The workshop was announced in the Newsletter of NoMiracle and DIALOGIK. Individual invitations were sent to experts of target groups and the announcements were disseminated in the mailing list of associations, industries and regulations. Also the workshop was offered as a student seminar

at the University of Stuttgart. Around 50 participants followed the invitation and we had a wide, interdisciplinary audience to discuss some ambitious topics.

1.4 Structure and programme of the workshop

The workshop avoided the usual sequence of presentation and discussion. The focuses were more on discussion and intensive exchange of arguments and practical advice. Therefore the organisers developed a unique format, but with the following classic sequence: what (perception and communication), how (methods), to what purpose (for assessment and management) with which results. This idea led to elaboration of the programme.

Thursday, 12th of April 2007

9.30 On-site Registration

**11.00- 13.00 Morning session:
Generic challenges of risk analysis: complexity, uncertainty and ambiguity****Welcome and opening of the workshop***Prof. Dr. Ortwin Renn, University of Stuttgart & DIALOGIK gGmbH**Dr. Hans Lokke, NERI, University of Aarhus***Coping with complexity, uncertainty and ambiguity: The need for interdisciplinary research and management***Prof. Dr. Ortwin Renn, University of Stuttgart & DIALOGIK gGmbH***Panel discussion: Addressing the challenges***Prof. Dr. Herbert F. Bender, BASF AG Ludwigshafen**Dr. Filip Cnudde, EU- Project SafeFoods, Wageningen University**Peter Van den Hazel, Public Health Services Gelderland Midden, Arnhem**Dr. Jürg Oliver Straub, F. Hoffmann-La Roche Ltd, Basel*

13.00 - 14.00 Lunch Break

**14.00 - 18.30 Principles of good risk communication:
"What determines success in risk communication?"****Lesson for Risk Communication: Methods and Results***Dr. Peter Wiedemann, German Research Centre Juelich, Programme Group
Humans Environment Technology (MUT)***Approaches in NoMiracle***Christina Benighaus, DIALOGIK gGmbH**Prof. Dr. Mikael Hilden & Dr. Timo Assmuth, Finnish Environment Institute
(SYKE), Helsinki*

16.00 - 16.30 Coffee Break

World Café: Group work

- Principles of good risk communication: "What determines success in risk communication?"
- Uncertainty and ambiguity: "How could social and cultural concerns be integrated in risk assessment and management?"
- How can risk communication be part in the NoMiracle project specifically for chemicals?

18.30- 21.00 Evening reception, Get-together

Friday, 13th of April 2007

9.30 - 12.30 Morning session: Learning from other EU-Projects

Result of the world café and discussion in the plenum

Interview of the participants

Moderation: Prof. Dr. Ortwin Renn, University of Stuttgart & DIALOGIK gGmbH

Case study: The STARC project: Stakeholders and risk communication

David Wright, STARC EU-Project, Trilateral Research & Consulting, UK

10.30 - 11.00 Coffee Break

Case study: Cross-Talking in the PHIME Project

Prof. Dr. Staffan Skerfving, Coordinator of the PHIME EU-Project, Division of Occupational and Environmental Medicine, Department of Laboratory Medicine, Lund University, Lund, Sweden

Case study: Towards a Precautionary and Inclusive Food Safety Governance

Dr. Marion Dreyer, Subproject 5 of the SafeFoods EU-Integrated Project & DIALOGIK gGmbH

Plenary Discussion

12.30 - 13.30 Lunch Break

13.30 - 15.00 Afternoon Session: Recommendation for the NoMiracle Project and the EU

Panel discussion: Learning from other EU-partner

Presenters of three case studies

Evaluation of the Workshop and final plenary discussion

Peter Van den Hazel, Public Health Services Gelderland Midden, Arnhem

Dr. Hans Lokke, NERI, University of Aarhus

Prof. Ortwin Renn, University of Stuttgart & DIALOGIK gGmbH

2 The NoMiracle project

By Hans Løkke

2.1 Project summary

To support current and future European strategies, in particular for environment and health, there is an urgent need for development of methods for assessing the cumulative risks from combined exposures to multiple stressors including from complex mixtures of chemical, physical, and biological agents. The NoMiracle project will help support the development and improvement of a coherent series of methodologies that will be underpinned by mechanistic understanding, while integrating the risk analysis approaches of environmental and human health.

The project will deliver understanding and new tools for risk assessment. It will help increase knowledge on the transfer of pollutants between different environmental compartments, including how these processes are influenced by natural stressors such as climate, pathogens and anoxia, and on the impact of cumulative stressors, including chemical mixtures. This will facilitate the link of information concerning the condition of air, water, soil and the built environment with human and ecosystem health monitoring data. By developing and using improved assessment tools and novel models, the project will quantify and aim at reducing uncertainty in current risk assessment and screening methodologies, e.g. by improving the scientific basis for setting safety factors. The new methods will take into account geographical, ecological, social and cultural differences across Europe. The IP consortium covers human toxicology and epidemiology, aquatic and terrestrial ecotoxicology, environmental

chemistry/biochemistry, toxicogenomics, physics, mathematical modelling, geographic informatics, and socio-economic science.

2.2 Project objectives

The interaction between environment and health is far more complex than is commonly understood. In particular, little attention has been paid to the interaction of different pollutants in the human body as well as in the environment. Even low level exposure over a period of time to a complex cocktail of pollutants in air, water, food and consumer products is likely to contribute significantly to the health status of European citizens.

Within this project we will improve both human and environmental risk assessment procedures by addressing a series of major shortcomings that exist within the current approaches, namely that:

- they are based on direct effects of single compounds or products
- they apply uncertainty factors which are not strictly based on scientific principles
- they do not account for multiple stressors and indirect effects in a dynamic and heterogeneous environment
- they typically do not account for cumulative (integrated over time, space, substances) effects, and
- they do not allow for site specific and other spatially detailed evaluations

Although it is generally acknowledged that chemical, biological, radiological, and other physical and even psychological stressors can cause a variety of human health or ecological health effects, assessing the risks associated with them is considerably more complex meth-

odologically and computationally than current risk assessment practices. Given these lacunas there is an urgent need for "cumulative risk assessment" which can be defined as "an analysis, characterisation, and possible quantification of the combined risks to health or the environment from multiple agents or stressors".

Development of a framework for such complex risk assessments will greatly improve understanding of the effects of cumulative exposures occurring under the variety of field conditions within Europe and will provide a better scientific basis for forecasting risks and associated uncertainties.

The understanding of the complexity of cumulative risks is a prerequisite for development of more efficient guidelines to provide data for future regulation of chemicals.

Science & technology objectives of the NoMiracle project

1. To develop new methods for assessing the cumulative risks from combined exposures to several stressors including mixtures of chemical and physical/biological agents
2. To achieve more effective integration of the risk analysis of environmental and human health effects
3. To improve our understanding of complex exposure situations and develop adequate tools for sound exposure assessment
4. To develop a research framework for the description and interpretation of cumulative exposure and effect
5. To quantify, characterise and reduce uncertainty in current risk assessment methodologies, e.g. by improvement of the scientific basis for setting safety factors
6. To develop assessment methods which take into account geographical, ecological, social and cultural differences in risk concepts and risk perceptions across Europe

7. To improve the provisions for the application of the precautionary principle and to promote its operational integration with evidence-based assessment methodologies

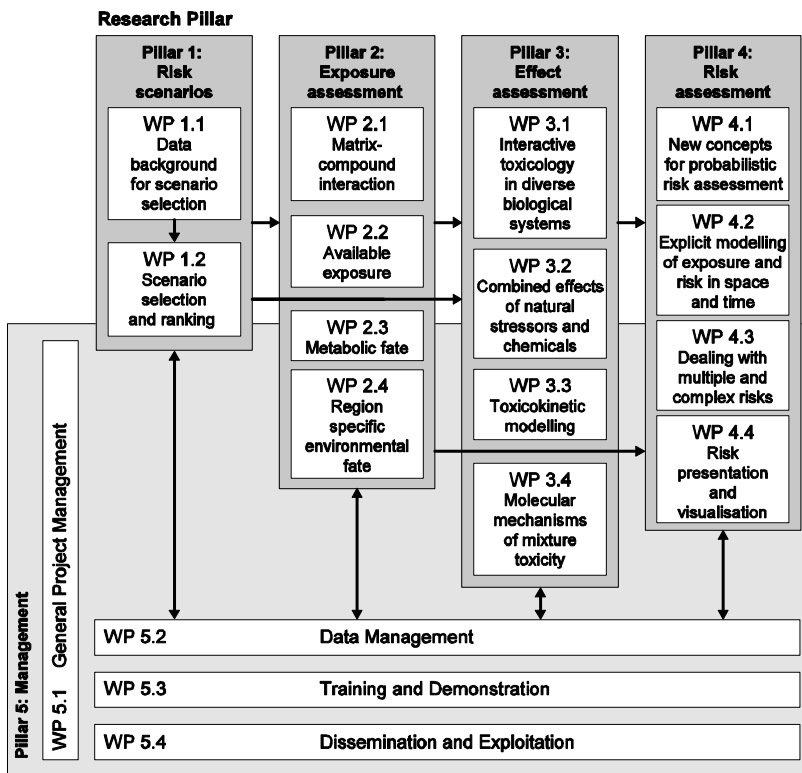


Fig. 1: NOMIRACLE activities and their components

2.3 Output from the NoMiracle project

NoMiracle will provide new concepts and methods to deal with existing and emerging chemicals in a real world of cumulative stressors:

Exposure assessment tools

- Methods for matrix-compound interactions
- Methods to measure available exposure, based on chemical activity and other novel approaches
- Methods for metabolic fate
- Models for exposure assessment, incl. modelling of exposure and risk in space and time

Integration of human health and environmental methods

- Risk scenarios to identify most likely combinations of chemical and other stressors, and methods to make risk mapping
- Exposure assessment (bioavailability) based on chemical activity
- Mechanistic approach in effects assessment, including uptake mechanisms
- Methods for toxicokinetics - single chemical uptake and interactive effects
- Demand for less use of mammalian test animals; in vitro methods and invertebrate testing in focus
- General biomarkers for human and environment
- New concepts and techniques for probabilistic risk assessment

Models and risk maps:

- Risk presentation techniques
- Spatial aggregation of risks to man and environment
- Multimedia fate and exposure model with varying spatial resolution
- Up-scaling methods based on small scale modelling
- Model for health risks in cities
- Ecological vulnerability analysis
- Development of methods to present and visualise risks

Development of methods for assessing and communicating combined effects of chemical mixtures and natural stressors

- Tools to predict the likelihood of synergism: Development of new methods for comparative risk assessment by integration of mixture toxicity and natural stressors (toxic stress, pathogenes, drought, temperature etc).

Development of methods for assessing uncertainty

- Separation of true uncertainty and individual variability in predicted risks of human populations from exposure to pesticides through all relevant environmental pathways
- Describing the metabolism and preliminary pharmacodynamic data in human subgroups. Derivation of uncertainty factors for subgroups and test species (single chemicals and mixtures)

Risk perception and communication

- Improving methodologies for efficient implementation of the precautionary principle in managing risks from chemicals and other stressors

- Looking for ways to integrate the precautionary principle with detailed scientific risk assessments
- Elaborating risk perception of combined risks: Compared with single risk scenarios, will chemical mixtures, or combinations of chemicals and other stressors increase public concern?

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3 Generic challenges of risk analysis: Complexity, uncertainty and ambiguity

The three generic challenges of risk analysis were considered in the first part of the workshop. The topic was introduced by a theoretical risk governance framework of the IRGC that provides guidance about how the risk communicator within the NoMiracle context could deal with the need for improved communication and stakeholder involvement.

The second part will describe the results of the first panel discussion with stakeholders from industry, NGO and regulation of how the different stakeholders in their work tackle the problem.

3.1 Risk Governance: Basic elements and requirements for communication and participation

By Ortwin Renn

3.1.1 Introduction

Governance refers to actions, processes, traditions and institutions, by which authority is exercised and collectively binding decisions are taken and implemented. *Risk governance* applies this process to the societal handling of risk. In addition, it suggests normative principles of good governance within the processes of conventional risk identi-

fication, assessment, management and communication. Risk governance thus incorporates such criteria as accountability, participation and transparency within the procedures and structures by which risk-related decisions are made.

Without good risk governance systems in place, many problems might occur such as:

- Unfair competition and unbalanced distribution of risks and benefits because of differing assessment and management principles
- Unfair burden sharing amongst generations, social groups, and regions
- Focus on low probability, but high profile risks to the neglect of higher probability, but lower profile risks
- Inadequate consideration of risk tradeoffs in management strategies
- Costly regulations
- Strategic business decisions that have failed to account for the impact of public perceptions about risk
- Loss of public confidence and trust in risk managers

In this respect, we have developed a framework of risk governance that tries to address these problems (IRGC 2005). It addresses the needs of policy-makers and regulators to take decisions on matters where there are some risks involved that may harm the society, the environment or the economy. Many of these risks are now complex, uncertain, or even ambiguous. In most cases, the potential benefits and risks interconnect. Our goal is to facilitate better understanding of risks - their scientific, political, social, and economic contexts - and how to manage them.

The risk governance framework comprises 5 phases. At each phase, a conclusion is made upon which decisions can be taken. These decisions are the result of a certain understanding in the risk analysis process. In this tool "governance gaps" are understood as deficits at one or several of the 5 phases, not necessarily at the main decision phase, which deals with whether the risk will be taken or not, and accompanied or not with mitigation or reduction measures.

The framework is also meant to provide a tool that enables arbitration or mediation between various interests, stakeholders, risks and opportunities. It is intended for leaders in government, business, academia, non-governmental organizations, and communities who are responsible for risk decisions, in particular about global and systemic risks.

The purpose of this paper is to give an overview of the framework and express the need for improved communication and stakeholder involvement.

3.1.2 How does it work?

Our framework is characterized by four main properties (see Fig. 1):

- The first one is an assumption: that risk handling does not start with risk management. It starts much before, at what we call "risk pre-assessment". The framework emphasizes the importance of this 'pre-assessment phase' in which the essential aspects of the risk issues, their analysis, evaluation, and in some cases, potential risk management options, are identified early. This step helps to promote agreement on the framing of the discussion from the

outset, thereby avoiding damaging omissions that could undermine the process later.

- The second important point is that whether a risk originates from a natural, a technological, an economic, or an environmental cause does not necessarily require different governance methods. What is more critical is whether the risk is simple, complex, uncertain or even ambiguous. It is the characterisation of the risk that determines how it can be handled.
- The third important is the up most importance of risk communication and the involvement of various identified stakeholders.
- The fourth element is the recognition of varieties in the risk cultures around the world, which will require different management methods. Also, as risk cultures vary over time and level of development, the timing issue is a key criterion. What is possible here may not be possible there. What is not possible today at a certain place may be possible tomorrow.

What are the five phases of risk governance?

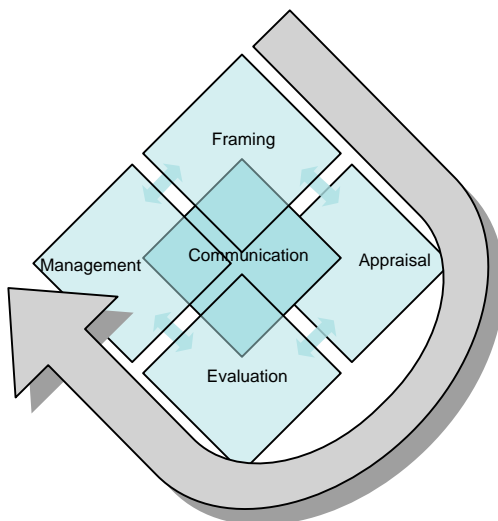


Fig. 1: Five phases of risk governance

3.1.3 Framing

The first phase mainly deals with early-warning and putting the risk in context. It defines the issue to be looked at and establishes a broad picture of all the elements that set the baseline for how a risk is assessed and managed. It captures, and brings to the open, both: The variety of issues that stakeholders and society may associate with a certain risk (and the related opportunities), and existing indicators, routines and conventions that may prematurely narrow down, or act as a filter for what is to be addressed as risk

The main question is "what are we talking about, how broad is the issue, who and what is involved and what are the boundaries".

- What are the risks and opportunities we are addressing?
- What are the various dimensions of the risk?
- How do we define the boundaries for our evaluations?
- Do we have indications that there is already a problem? Is there a need to act?
- Who are the stakeholders? How do their views affect the definition and framing of the problem?
- What are the scientific/analytical tools and conventions that can be used to assess the risks?
- What are the current legal/regulatory systems and how do they potentially affect the problem?
- What is the organisational capability of the relevant organizations, governments, international organizations involved?

In this phase, deficits can be perceived at various levels:

- *Awareness: "I was not aware that there was a risk there". The knowledge or perception is insufficient.*
- *Warning: the signals have not been detected or recognised.*
- *Scope: a risk which is perceived as having only local consequences may in fact be much broader.*
- *Framing: different stakeholders may have conflicting views on the issue*
- *Information: lack of raw information*

3.1.4 Appraisal

This phase provides a number of criteria by which the risk can be characterized. It provides the knowledge base for the societal decision on whether or not a risk should be taken and, if so, how the risk can possibly be reduced or contained.

Risk appraisal thus comprises both a scientific assessment of the risk (a factual dimension describing the physical measurable characteristics and outcome) and a concern assessment of the questions that stakeholders may have concerning its social and economic implications (a socio-cultural dimension that describes how the risk is viewed when values and emotions come into play).

The types of questions that the scientific assessment deals with are:

- What are the potential damages or adverse effects, what is the probability of occurrence, how ubiquitous could the damage be? How persistent? Can it be reversible?
- What are the complexities involved in making the assessment?
- What scientific, technical and analytical approaches, knowledge and expertise should be brought to better assess these impacts?

The types of questions that the concern assessment deals with are:

- What are the public's concerns and perceptions?
- What is the social response to the risk? Is there a risk for potential conflict?
- What role are existing institutions, governance structures and the media playing in defining public concerns?

- Are risk managers likely to face important ambiguities arising from differences in stakeholder objectives and values, or from inequities in the distribution of benefits and risks?

In this phase, governance deficits can be perceived at various levels:

- *Knowledge: there is a lack or scarcity of scientific data or concern information, or a failure to accept knowledge*
- *Confidence: there is a low confidence level in the data, the model or the theoretical interpretation of the modelled outcomes*
- *Lack of attention for interactions between agents and between agent and target: Multiple causes of risks or multiple exposures to different hazards have not been addressed or the influence of behaviour on exposure or effects has been underestimated*
- *Inadequate attention to concerns: The associations or concerns of stakeholders and individuals were not properly assessed or acknowledged*

3.1.5 Evaluation

This phase is the most controversial.

It aims to make a judgement call on whether or not a risk is acceptable or at least tolerable (in view of the benefits it provides – and if subject to appropriate risk reduction measures).

Input for this decision comes both from:

- The compiling of scientific evidence gained in the appraisal phase (risk and concern characterisation) and

- Incorporating broader value-based issues and choices that also bear on the judgement (risk judgment).

The questions that risk analysts may ask are:

Risk and concern characterisation:

- What are the societal benefits and risks?
- Are there impacts on individual quality of life?
- On ethical issues?
- Is there a possibility of substitution?
- Does the choice of technology impact on the risk? How?
- What are possible options for risk compensation, or reduction?

Risk judgment:

- What are the societal values and norms for making judgement about tolerability and acceptability?
- How can tradeoffs be assigned to competing safety, health, economic, social and individual goals?
- Do any stakeholder, government, business or other, have commitment or other reasons for desiring a particular outcome of the risk governance process?
- Is the risk acceptable, needing no reduction or mitigation measures, or is it "unacceptable"?
- Is it tolerable, requiring measures to mitigate the potential negative consequences?

At this level, governance deficits can be found:

- *when some stakeholders are accidentally or deliberately excluded from the judgement process*

- *when there is indecision or lack of responsiveness, whether voluntarily (act of authority) or involuntarily (overly inclusive process with stakeholders leads to inertia)*
- *when tradeoffs are not made explicit and hidden agendas seem to determine the outcome of the evaluation process*
- *when the timing issue is not properly addressed*

3.1.6 Management

All tolerable risks will need appropriate and adequate risk management.

This phase designs and implements the actions and remedies required to tackle risks with an aim to avoid, reduce, transfer or retain them. Based on the development of a range of options, risk management decisions are taken and put into practice.

The questions are:

Decision making:

- Who is responsible for decisions within the context of the risk and its management?
- What management options could be chosen (technological, regulatory, institutional, educational, compensation, etc)?

Implementation:

- What are the impacts associated with choice of particular risk reduction options (cost, compliance, effectiveness, equity, sustainability, acceptability, etc.)?
- What potential trade-offs between risk and risk reduction measures may arise?

- What measures need to be put in place to ensure effectiveness in the long term (monitoring, adaptive management plans, etc.)?

The governance deficits often found in the management phase are:

- *Lack of information: may lead to inappropriate decision*
- *Sustainability: decisions are short-term and will lead to further, secondary problems*
- *Immediacy: authority makes decision on knee-jerk basis to give impression of management*
- *Time lapse: new knowledge requires that risk decision be revisited*
- *Indecision/timeliness: matters are made worse by delays or inaction*
- *Lack of fairness: decisions are inequitable*
- *Implementation: decisions are ignored or poorly implemented*

3.1.7 Communication

Communication is of crucial importance in all phases of addressing and handling risk. It should enable stakeholders and civil society to understand the risk itself and the rationale of the results and decisions from the risk appraisal and risk management phase. It enables them as well to understand their role in the process, to make informed choices about the risk, balancing factual knowledge about it with their personal interests, concerns, beliefs and resources. Effective communication is the key to creating trust in risk governance.

Questions:

- What is known about the risk?
- How can the difference between hazard and risk be successfully conveyed to the different parties?

- What are the demand, need and purpose for information and communication?
- How can communication be organised so that information can be effectively provided?
- What has been and can be the role of the media?
- Who controls information? Is it accepted?
- What is the degree of confidence in those responsible for generating/or disseminating information, and for organising a dialogue?
- Have communications had their desired effect? Was there an appropriate and well-designed effort to get feedback on the communication?

The most important governance deficits that are found in the communication phase are:

- *One-way information instead of two-way communication prevents building dialogue.*
- *The communication is not adapted to the category of risks and the stakeholders involved.*
- *Concerns are treated as irrational fears and thus stigmatised (which may result in a high degree of social mobilisation against the risk management institution)*
- *Low level of confidence or trust in the information given and in the decision-making process weakens the whole process.*

Characterisation of the risk issue

There are a number of ways to characterise a risk issue. For example, the following criteria can be used in classifying risks:

- *Emerging - re-emerging– rising – current – institutionalised*
- *Scope: local, dispersed, transboundary, global, international cooperation*
- *Impact on: health and safety, the environment, societal values, trade, business, actors' power, equity*
- *Possibility of transfer: yes/ insurability – no/resilience*
- *Probability of occurrence and intensity*
- *Damage: persistence, reversibility, delay effects*
- *Level of public concern and stakeholder involvement*
- *Regulatory framework: regulation/guidelines/laissez-faire, national/international, compliance issues*

Our approach introduces a new (additional) characterization scheme that classifies risks according to the degree of knowledge about risks.

For example, relatively simple risks (e.g. home fire safety), where the benefits of taking regulatory action may be straightforward and uncontroversial (e.g. smoke detectors) require a different approach to risk evaluation and governance than risks that are increasingly complex, uncertain and/or ambiguous (with respect to the perceptions and values associated with the risks).

- Complexity refers to difficulties in identifying and quantifying causal links between a multitude of potential causal agents and specific observed effects. Examples of highly complex risks in-

clude failure risk of large interconnected infrastructures and risks of critical loads to sensitive ecosystems.

- Uncertainty refers to a lack of clarity over the scientific or technical data. Highly uncertain risks include many natural disasters, acts of terrorism and sabotage and the long-term effects of introducing genetically modified species into the natural environment.
- Ambiguity results from divergent or contested perspectives on the justification, severity or wider meanings associated with a given threat. Normative ambiguities can be associated, for example, with passive smoking and nuclear power. Risks subject to high interpretative ambiguity include food supplements and hormone treatment of cattle.

Distinguishing between simple, complex, uncertain and ambiguous risks can help to design a risk management strategy.

- Simple risk problems can be managed using a 'routine-based' strategy, such as introducing a law or regulation.
- Complex risks can be addressed on the basis of accessing and acting on the best available scientific expertise, aiming for a 'risk-informed' and 'robustness-focussed' strategy.
- Uncertain risks are better managed using 'precaution-based' and 'resilience-focussed' strategies, with the intention being to apply a precautionary approach to ensure the reversibility of critical decisions and to increase a system's coping capacity to the point where it can withstand surprises.
- Finally, for ambiguous risk problems the appropriate approach comprises a 'discourse-based' strategy which seeks to create tolerance and mutual understanding of conflicting views and values with a view to eventually reconciling them.

3.1.8 Stakeholder Involvement

We have broadened the concept of risk assessment to include the scientific consideration of risk perceptions and other individual, social and cultural concerns about the consequences of risks as equally relevant inputs to risk evaluation and risk management. Very few risk governance models currently include procedures or guidance for how, or when, to involve the concerns of stakeholders – particularly the general public.

Governance deficits can be perceived in the case of:

- *Exclusion: accidental or deliberate exclusion of stakeholders and/or their views*
- *Responsiveness: a deficit in responsiveness, a deliberate failure to act or a refusal to accept knowledge leads the stakeholders with power to decide, irrespective of need for consultation and dialogue ("Authority knows best")*
- *Too many good intentions: selection of an overly inclusive process leads to inertia or indecision (analysis by paralysis)*

3.1.9 Conclusion

Our risk governance framework is an innovative, comprehensive and consistent, yet flexible set of guidelines for identifying, understanding and addressing the elements that are the essential components of sound risk governance. It is not intended as a recipe or a checklist which can guarantee that no relevant aspects gets overlooked while analysing a risk and its governance process and structures. The framework cannot replace thinking or, for that matter, creativity. It is however hoped that, by building into conventional "risk analysis"

soft issues such as societal values, concerns as well as perceptions of risk and by looking into the interactions required between the various actors involved in the process, it can contribute to the development of better balanced and more inclusive risk governance strategies.

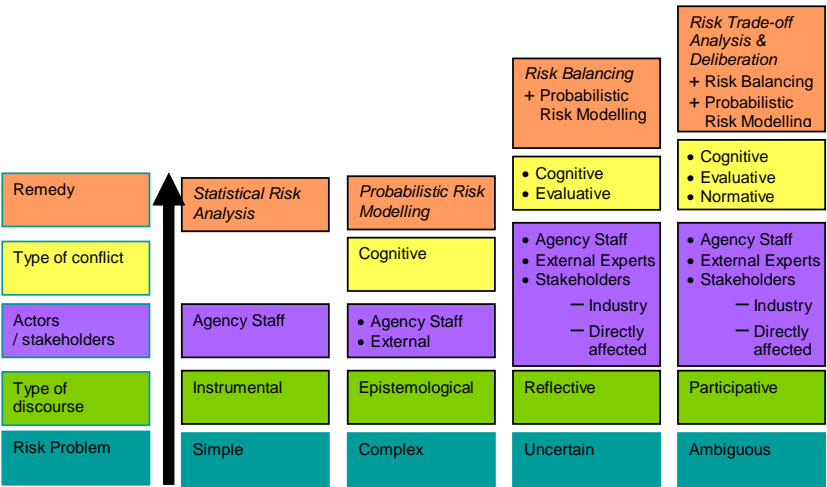


Fig.2: Escalator of Risk Management

Reference:

International Risk Governance Council (IRGC): White Paper No1 *Risk Governance – Towards an Integrative Approach*, written by Ortwin Renn with an Annex By Peter Graham. IRGC: Geneva 2005

4 Panel discussion: Addressing the challenges

By Ludger Benighaus & Christina Benighaus

After an introductory speech by Ortwin Renn, the panel discussion aimed at answers on how to deal with risk communication challenges.

Four experts from different backgrounds had been invited: With Prof. Herbert F. Bender (BASF) and Dr. Jürg Oliver Straub (F. Hoffmann-La Roche Ltd.) two managers from the chemical industry stepped forward to share and discuss their experience. Dr. Filip Cnudde is actively involved in addressing risks in the food sector within the EU-funded project “Safe Foods”, and Peter van den Hazel is communicating risks in relation to his position at the Public Health Services Gelderland Midden in Netherlands.

“An open and regular contact with NGOs is recommendable for huge companies”, debated Prof. Herbert F. Bender. His company BASF enters into conversation with active groups before something happens. They try to understand groups' ideas and arguments, and to compare these with their own position. It happens that the positions are different, and the managers in charge try to make clear that a risk free industry does simply not exist. Prof. Bender argues that it is not the point whether there is a risk or not, but rather, if the risk is tolerable or not.

“We try to avoid numbers and technicalities as much as possible”, explained Dr. Jürg Oliver Straub as his personal experience. He is not

trying to hide the issue, but to explain there is a problem, and that everybody could be exposed at any moment, even in this room. The public often accepts that there is a minimal unavoidable risk, whereas politicians may be more apt to reject the possibility. It once happened that an internal report was offered to a politician, but he declined the document and didn't want to know it. It was not the politicians' motive to communicate to the community.

"The food safety sector is not easy to compare with the chemical industry", stated Dr. Filip Cnudde at the outset. Outrage emotions are always very strong, and because we all are food consumers, in the food sector everybody feels highly involved. Food becomes part of everyone, and therefore risks are imposed involuntarily in a widespread manner. Risks from the chemical industry tend to be more localized for the people living in the neighbourhood of a chemical plant. Part of the project "SAFE FOODS" focuses on talking in messages, and on identifying who is really the target group. One of the problems is the overload of information, and the necessary information should be readily there when needed. In communicating about food safety, Filip Cnudde recommends limiting one's ambitions to clear transmission of the information that the people absolutely need.

The job of Peter Van den Hazel entails translating the results of the risk assessments to risk regulators and to other target groups as well.

While visiting politicians, informing them about risks, and what could go wrong, he is often confronted with hidden agendas. Speaking with the public, the politicians might suddenly come up with their hidden agenda, and cause trouble within the process of risk communication. He experienced one incident in which a mayor wanted to increase the employment with the help of a company, and the risk issue disturbed his plans. The mayor wanted to keep this company within the borders of his district. It usually backfires on the politicians if they try to go their own way. Mr Hazel always tries to

make clear to politicians and risk regulators the importance of being very transparent, and advises them to use all the data the risk assessment has provided them with.

5 Principles of good risk communication: "What determines success in risk communication?"

One of the two keynote speakers was Dr. Peter Wiedemann, who presented his insights about risk perception and emotions and their effect on the work of a risk communicator.

5.1 Lessons for Risk Communication: Methods and Results

By Dr. Peter Wiedemann

"Precautionary measures can trigger concerns and amplify risk perception", the first key note speaker Dr. Peter Wiedemann made clear in his presentation. As experimental studies have shown, informing people about precautionary measures may not decrease the perception of risk – as may be expected by regulators and policy-makers – but rather increase perceived risk. This effect should be taken into account when disseminating information about precautionary measures.

Dr. Peter Wiedemann also explored the influence of risk stories in societal representation of risk events. These narratives often follow a certain sequence: First there is the casting of persons in particular roles, followed by ascribing objectives and motives. The story is dramatised by attributing logic to the event, and the consequences and

and harm are described. The final step comes in formulating a conclusion or lesson to be drawn (moral of the story). Depending on how the actors and the other story elements are portrayed, risk perceptions can be either amplified or attenuated – without changing the actual magnitude of the risk. This sensitivity to the context in which a risk is presented is a characteristic of risk perception of which risk managers should be aware.

- Good risk communication aims at the empowerment of the people, i.e. supports their competencies to understand and make decisions about risks.
- Provide a balanced and reasonable description of the evidence on which the risk assessment is based.
- Perceived social responsibility by risk creators can improve their role in the story.
- Test your message. Be aware of unintended effects.

Key messages of the presentation:

- Good risk communication aims at the empowerment of the people, i.e. supports their competencies to understand risks
- Provide a balanced and reasonable description of the evidence on which the risk assessment is based.
- Perceived social responsibility can make a difference.
- Test your message. Be aware of unintended site effects.

Here is the complete set of transparencies Peter Wiedemann used.

Risk Communication: Methods and Results

Stuttgart, 2007

Peter Wiedemann

Forschungszentrum Jülich



- Risk Communication:
"... Interactive exchange of information
about risks among risk assessors,
managers, news media, interested groups,
and the general public.

International Union of Pure and Applied Chemistry.
Risk assessment terminology. Chemistry International
Vol. 23, No. 2. March 2001. John H. Duffus.
[http://www.iupac.org/publications/ci/2001/march/risk_](http://www.iupac.org/publications/ci/2001/march/risk_assessment.html)
[assessment.html](http://www.iupac.org/publications/ci/2001/march/risk_assessment.html)

Seven Cardinal Rules of RC

- Accept and involve the public as a partner.
- Plan carefully and evaluate your efforts.
- Listen to the public's specific concerns.
- Be honest, frank, and open.
- Work with other credible sources.
- Meet the needs of the media.
- Speak clearly and with compassion.



Covello and Allen 1988

“Risk communication is not just a matter of good intentions and a thoughtful analysis of motivations. Risk messages must be understood by the recipients, and their impacts and effectiveness must be understood by communicators. To that end, it is not longer appropriate to rely on hunches and intuitions regarding the details of message formulation.”

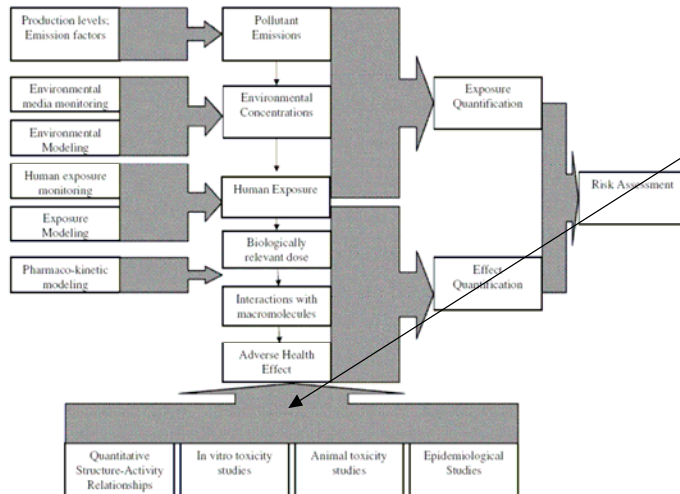
(Morgan & Lave, 1990, 358).

Key Issues for Risk Communication

- How to deal with uncertainties?
- How to provide a transparent, consistent, and reasonable risk characterization?
- How to deal with emotions?
- How to communicate precautionary measures?

How to Deal with Uncertainties?

Uncertainty in Risk Assessment



Key issue:

Causality is
in dispute

Figure 1. General environmental health framework for risk assessment.

Adapted from

Source: Kandlikar, Ramachandran, Maynard, Murdock & Toscano (2007)

Empirical Studies

Study	Focus	Results
Johnson & Slovic 1995, 1998 & Johnson 2003	Interpretation of information about uncertainties	<ul style="list-style-type: none">• Majority of subjects prefers certainty over uncertainty• Uncertainty is attributed to personal factors (e.g. incompetence)
Miles und Frewer 2003	Effect of information of different types of uncertainties in risk assessment on risk perception	<ul style="list-style-type: none">• Results are context specific• Uncertainties with respect to risk management, magnitude of the risk, <and inter-species generalization have the biggest impact
Kuhn 2000	Interpretation of risk estimates	<ul style="list-style-type: none">• Concerned people believe in worst-case-estimates

Summary

- Communicating uncertainty leads into a dilemma
 - Transparency is a ethical requirement, therefore revealing the uncertainties of risk assessments seems to be necessary
 - However, without risk literacy , i.e. basic knowledge about risk assessment principles, information about uncertainties may lead to confusion and misunderstanding.

Key message 1

- Good risk communication aims at the empowerment of the people, i.e. supports their competencies to understand risks
 - Difference between risk & hazard
 - Uncertainty is a unavoidable component of risk assessments

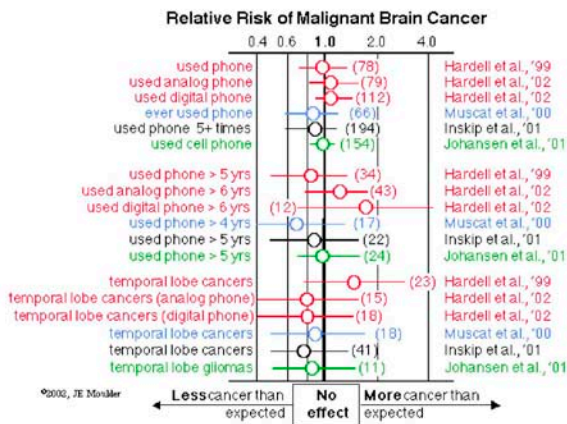
How to Provide a Transparent,
Consistent, and Reasonable Risk
Characterization?

Characterization

- Is there a hazard?
- How likely is it ?
- How much evidence is available?
- How good is the evidence?

Characterization

Inconsistent evidence

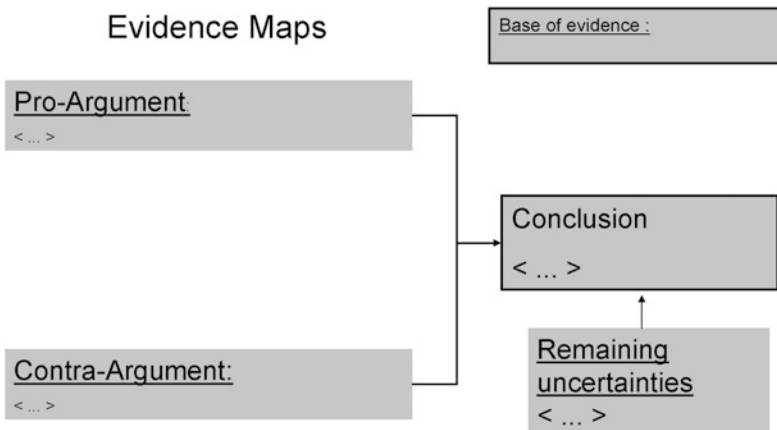


Characterization

Idioms in order to describe uncertainty and contradictory evidence:

- "probably no relationship",
- "rather unlikely",
- "a relationship cannot be excluded",
- "not likely, but possible",
- "vague initial suspicion".

Characterization



Summary

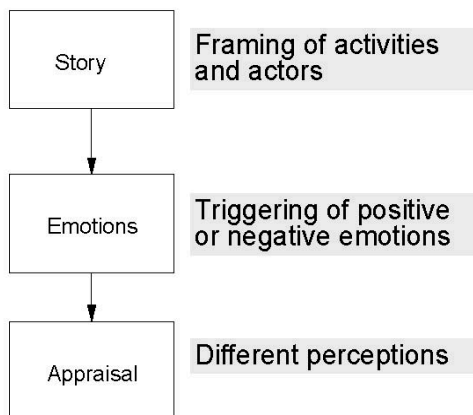
- Characterization is a key issue
- Provide a transparent description of the underlying evidence
- Give the pro's and the con's
- Inform about both sides: Certainty and uncertainty

Key Message 2

- Provide a balanced and reasonable description of the evidence on which the risk assessment is based.

How to Deal with Emotions ?

Emotions in risk perception

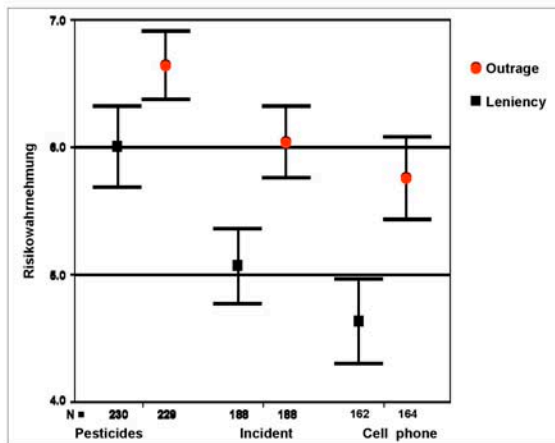


Emotions in Risk Perception

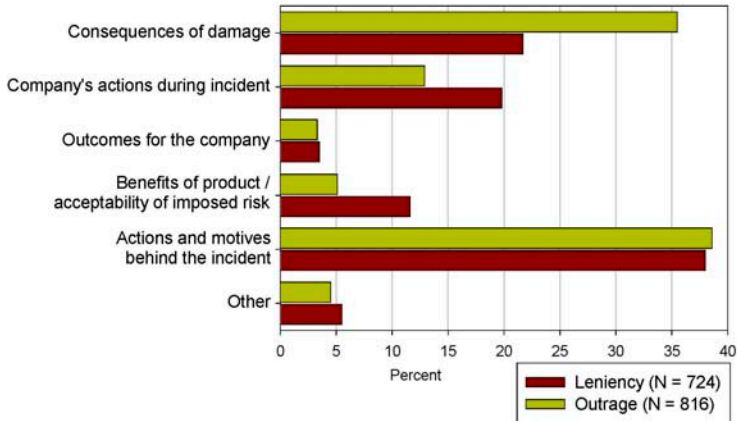
What risk stories do:

- casting the persons in particular roles
- ascribing objectives and motives
- attributing a logic to the event (dramatization)
- describing the consequences (harm),
- formulating a conclusion or lesson to be drawn (moral of the story)

Emotions in Risk Perception



Emotions in Risk Perception



Summary

- Take into account: Perceived risk \neq hazard + exposure
- Be aware of story effects
- Risk stories influence trust and confidence

Key Message 3

- Perceived social responsibility can make a difference.

How to Implement Precautionary Measures?

Precautionary Measures

Objectives:

- To anticipate possible threats to health and respond appropriately in order to reduce exposures before introduction of an agent.
- To address public concerns that a potential or perceived but unproven health problem is taken into account after introduction of an agent.

WHO

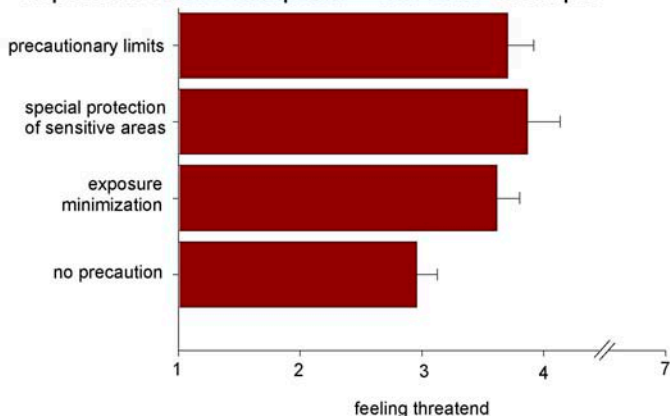
Precautionary Measures

How do people respond to precautionary measures?

- Do precautionary measures influence risk perception, and if so, in which direction?
 - Do precautionary measures influence trust?
-

Precautionary Measures

Impact on Risk Perception - The EMF example



Wiedemann & Schuetz
Environmental Health Perspectives, 2005

Summary

- Precautionary measures can trigger concerns and amplify risk perception.
- Policy makers should take into account such side effects.

Key Message 4

- Test your message. Be aware of unintended site effects.

Key Messages

- Empower the people, i.e. help them to develop risk competencies
- Provide a balanced and reasonable description of the evidence on which the risk assessment is based.
- Perceived social responsibility can make a difference.
- Test your message. Be aware of unintended site effects.

“What is simple is wrong,
what is complex is useless.”

Paul Valéry

Thank for your attention!

www.fz-juelich.de/mut

Approaches in NoMiracle

6.1 Risk communication in the NoMiracle project

By Christina Benighaus

Technical and social science perspectives in risk analysis

The NoMiracle project aims to improve the development of methods to assess combined exposure of multiple stressors. The project analysis more technical risks, as could be demonstrated by the main four tasks of the project:

- scenario selection: substances/target, scale of analysis
- Exposure assessment: models choice for fate (human and environment) and assess exposure
- Effect assessment: method to evaluate toxicity of mixture
- Risk assessment: comparing exposure assessment with toxicological data

“RA may be a special subdiscipline within the whole RA complex that is characterised by formalisation through guidelines which in turn already contain and refer to the results of scientific, political and (possibly, hopefully) societal discussion and evaluation”, said Jürg Oliver Straub as his personal experience at the workshop in Stuttgart. “Hence, Risk Communication with/to regulators is mainly on a technical level,” he continued.

In the social science view the technical risk analysis is only one part of the whole risk analysis cycle in the society. The technical risk analysis calculates probabilities of risks and structures the results into damage categories. This allows formal appraisal of the risks.

The social science analysis broadens the technical risk analysis and delivers arguments and insights, which critically question validated technical risk analysis. Not the question *"How safe is safe enough?"* is relevant, but the political issue of decision making *"How fair is safe enough?"* (Rayner & Cantor 1987).

"What does this mean within NoMiracle?", asked Jürg Oliver Straub at the workshop. "I personally believe that the main inputs from NoMiracle will be firmly on the technical side. You want to improve RA, which for me means that we need new and better tools to assess potential risks arising from complex situations with a higher degree of certainty, as Prof Renn put it, based on better evidence and integration of this evidence and eventually being less dependent on black-box precaution (personal view)."

The NoMiracle project integrates risk assessment in a wider governance concept that combines the "technical" dimension of risk and the "socio-cultural" context (social risks, benefits, concerns).

6.1.1 The Risk Governance Cycle

The traditional concept of Risk Governance contains normally three components which are separated in the different parts risk assessment, risk management and risk communication. In the traditional concept the NoMiracle part is enclosed in the component risk assessment. Risk management and communication will be taken over by stakeholders in regulation, economy and politics.



Fig. 1: The traditional risk governance contains three components

The „*International Risk Governance Council*“ (IRGC) developed 2005 the Risk Governance Cycle, which combines both perspectives, the technical and the social science approach.

The IRGC wanted to integrate the varying terms in the different disciplines in a framework, and to create an innovative evaluation instrument for complete, effective, efficient and socially acceptable governance of risk (IRGC 2005, 17).

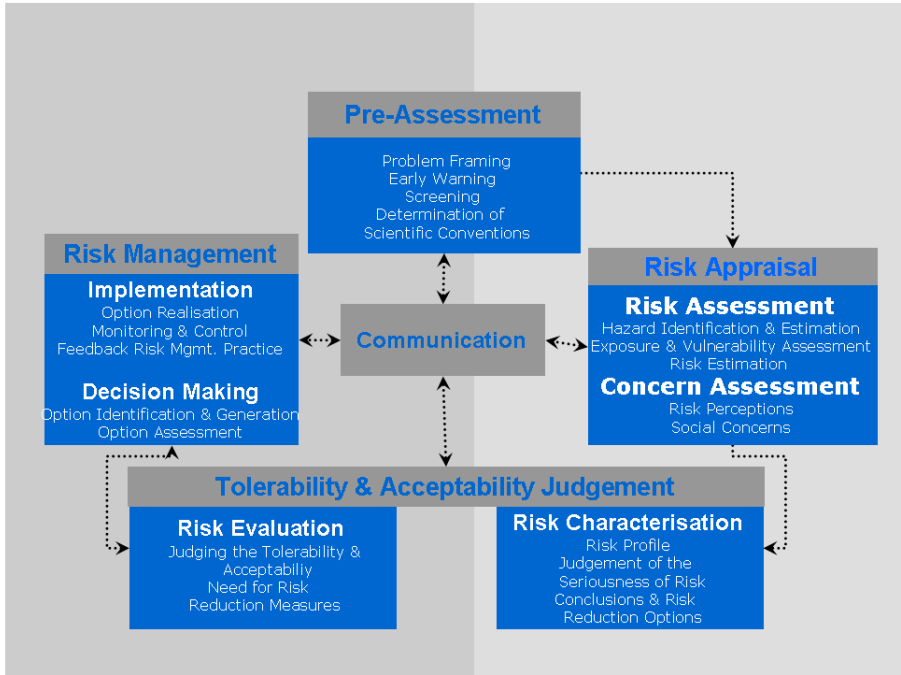


Fig. 2: Risk Governance Cycle of the IRGC

6.1.2 New Elements of the Cycle

The principal distinction between the knowledge gaining tool (assessment sphere) and the decision-making tool (management sphere) can still be identified as in the traditional cycle. But there are also new elements, which combine these two generic steps. I will highlight here only a few. A detailed description of the cycle is given in chapter 3.1. “Risk Governance: Basic elements and requirements for communication and participation” by Prof. Ortwin Renn.

One important change is the „*Pre-Assessment-phase*“ with the „*Framing*“ of the risk assessment and evaluation. The „*Framing*“ defines, if this phenomenon is actually seen as a risk, and if yes, which causally determined functional chain from which target group should be looked at (Tversky & Kahneman 1981; van der Sluijs et al. 2003; Goodwin & Wright 2004). For example, it makes a difference, if a risk, like the consumption of functional foods, is perceived and assessed by farmers, food industry, consumers or environment activists (Renn 2007: 68).

The second phase of the IRGC model is devoted to the risk appraisal. Here risk assessment is differentiated from concern assessment (IRGC 2005, 26ff.). Physical risks will be analysed by the best available scientific methods, and if possible, quantified. The results of this scientific diagnosis could be incorporated into the risk evaluation.

After possible effects and activities are collected, steps for risk characterisation, evaluation and judgement are designed (IRGC 2005, 36ff.). Here the acceptability and the benefit of the risk play a significant role. Formal judgements, norms and values are incorporated in this phase. The more controversial the risk is discussed, the more difficult is the solution of trade-offs. An adjudgement over the acceptability and tolerability of risks stands at the end of this process (Fairman 2007; Renn 2007).

The fourth step is risk management. It describes development and selection of measures, in order to avoid or reduce non acceptable risk, and handle it till it is acceptable (IRGC 2005, 40ff.).

One very important change is the central position of the risk communication. It does not stand at the end of the traditional risk governance process, but in the centre of the cycle and it to be understood as a mutual leaning process. The IRGC considers risk communication as a permanent process, which lasts from the pre-assessment up to the risk management (IRGC 2005, 54ff.). Early and comprehensive communication about risks is not only a democratic postulation, but could enrich management processes (Lundgreen 1994; Stern & Fineberg 1996).

NoMiracle has no direct mandate to study risk communication, yet the project emphasizes the need to find the most appropriate way to communicate its approach and its results to the EU administrators, experts, stakeholders and the public.

6.1.3 Main tasks in the work package 4.3 in the NoMiracle project

Review of risk perception literature (DIALOGIK):

- Different social and cognitive concepts of risk
- Specific risk perception of lay-persons and experts
- Conclusions for risk communication and risk assessment
- Submitted to the peer review Journal of Risk Research

Review of frameworks of risk information:

- Definitions of risk and related concepts to examine the implications of these for risk information (SYKE)

Survey, what do experts and stakeholders think about risks and uncertainties?

- implications for methodological development and communication
- For more details please see chapter 6.2 “Survey results: Expert and stakeholder views of risks and uncertainties by Timo Assmuth, Mikael Hildén, and Jari Lyytimäki.

Social concerns of consumers and the public (in autumn 2008):

- focus groups with consumers and the public on basis of the case study of NoMiracle, analyse communication needs:
- how they deal with the uncertainty, how they want the information of chemical and cumulative risks to be presented (DIALOGIK)

Ongoing work

As recommendations of the Open-Workshop in Stuttgart:

- code of good practice of risk communication in the NoMiracle context
- Review the risk assessment cycle and show the differences between the governance cycle and technical Risk assessment

Dr Jürg Oliver Straub (personal view):

"I got the impression that there are no good or agreed guidelines for RC, while at least regionally (AUS, NZ, CDN) there are such accepted guidelines for RA according to David Wright.

Hence, for me, one possible product from this workshop might be a sketch or proposal or code of good practice for RC, to be presented in the form of a publication from NoMiracle participants. We found in the World Café several basics for good or improved RC, which in my recollection on the personal side centred mainly on trust; after returning home I think that mutual respect is probably a prerequisite basis for trust, hence it might need to go into these considerations, too. Respect also integrates well with honesty as another necessity for good RC.

Some thoughts or possibly some kind of editorial or review on the continuum of the whole RA cycle and the differences between the whole cycle and technical RA might be another idea, also including the nature, scope and importance of RC in the various disciplines of RA."

References:

IRGC, International Risk Governance Council 2005. White Paper on Risk Governance. Towards an Integrative Approach. Author: O. Renn with Annexes by P. Graham. International Risk Governance Council. Geneva.

Rayner S., Cantor R. 1987. How Fair is Safe Enough? The Cultural Approach to Societal Technology Choice. Risk Analysis 7: 3-13.

6.2 Expert and stakeholder views of risks and uncertainties: A survey

By Timo Assmuth, Mikael Hildén, and Jari Lyytimäki

6.2.1 Background and objectives

In comparison with studies of public perceptions of risks from chemicals, relatively little attention has been paid to the actual production and use of information on such risks (but see Okrent, 1998; Sjöberg, 2001). Some studies have investigated the role of experts and of perceived uncertainty of risks. Also the perceptions of stakeholders have been studied in comparative European surveys (van Kleef et al., 2006). Generally important studies of perceptions of experts have also been made in relation to other kinds of environmental risks such as those of climate change (Lowe and Lorenzoni, 2007) and nuclear power (Yim et al., 2003).

Analyses of experts' views of risks are essential for understanding how societies produce and deal with risk information. Much of it is processed and transmitted between researchers and other experts acting within or in direct connection with policy development and regulatory processes. These frameworks affect the nature of the information and the demand put on it (Assmuth and Hildén, 2006). However, the divide between expert and lay knowledge in understanding and addressing risks is becoming increasingly blurred.

Broader participation in risk management and in governance in general has become a common goal also in EU, in part along with overall development of science and policy frameworks that emphasize transparency and access to information. Extended peer communities

and co-production of policy expertise have gained interest (Corburn 2007). This has created new challenges for the assessment and management of risks and for the generation and use of knowledge. The perceptions and views of experts and stakeholders continuously play a key role, and need to be studied (Pidgeon, 1998; Sjöberg et al., 2005; Young and Matthews, 2007).

Here we present results from a survey that focused on issues related to European level risk assessment, management and communication in the context of chemicals, on uses and limits of knowledge in these activities, and on the characteristics of chemical risks. The survey was targeted to researchers, other experts and stakeholder representatives working on and familiar with chemical risks. Their expertise ranged from science and risk assessment to administration, industrial applications and policy making. They included researchers, consultants and managers in public institutions, industry and NGOs. For details of the survey, see Assmuth et al. (2007a).

The objectives of the survey were to give a general picture of perceptions and views among experts and stakeholders concerning risks, risk assessment and risk management, and to identify issues and opportunities for subsequent studies and communication. In particular, views were solicited from experts and actors in chemical risks on key topics of the NoMiracle (Novel Methods for Risk Assessment of Cumulative Stressors in Europe) project, with an emphasis on complex risks and uncertainties in chemicals management context.

6.2.2 Methods

The method used was a web-based on-line survey that combined regular Likert-type questions (degree of agreement with statements)

and a novel approach that charted the views on the importance of different types of information in a two-dimensional graph describing the use of information in regulatory treatment and public discussion. A third part explored the ranking of separate and cumulative risks in map grids and views on presenting risks using maps (Assmuth et al., 2007a).

The survey was e-mailed to 952 recipients representing researchers, national and EU level administrators, industry, NGOs and European Parliament, and most EU member states and some other countries. All in all 247 replies were received, typically from male middle-aged PhDs with over 10 years experience in environmental or health area. The response rate (26 %; 37 % for those on the NoMiracle mailing list) is considered acceptable but limits possibilities to make quantitative claims concerning the views held by different groups. The sample is, however, sufficient for identifying the range of views that exists and tendencies in them.

6.2.3 Results and discussion

General

Those who responded tended to give answers to all or most of the questions, suggesting that on the whole the survey was balanced and well tested. Respondents were able to grasp and reply also to the novel two-dimensional and map evaluation questions in an on-screen Internet-based configuration. A key finding was the pronounced variability of views regarding risks and uncertainties and the use of information related to these. It can only partly be explained by the survey methodology, or by background factors (affiliation or country, or the field of expertise). There are thus similarities in views across and marked differences within easily identifiable groups.

Strong co-variation of responses to some of the questions could be observed both within and between survey sections, suggesting regu-

larities in underlying mental constructs (e.g. opinion patterns, overall values and views, and type of expertise).

In addition to scatter of replies, strongly divided opinions were found on some issues. For example, views were clearly divided on the claims that "Human health risks of chemicals more important than their ecological risks" and "Long-term risks of chemicals are more relevant than their immediate risks". The survey can thus help in identifying issues of disagreement, including differing interpretations, and factors related to such disagreements. Some disagreements are likely to be related to the type and level of information and experience, others to fundamental beliefs and values.

Importance of different types of information

The views on the importance of information indicate that the context of its use and purpose play a role. Some items, notably information related to modelling and other information related to the more technical aspects of risk assessment and management, were perceived to be important mainly in legally based formal treatment of risks. Such information was seen by many as key issues for 'professionals, not public' (Fig. 1). Fewer items were regarded as being mainly important for public debate, but for example narrative descriptions of risks were seen to belong to this category.

Differences in general attitudes to broad public engagement in risk management were found. Some experts clearly want to maintain the divide between experts and non-experts whereas others recognize the blurring of the divide and see public debate as an integral part of risk management. This difference can also be seen in the views on uncertainties: many see that information on uncertainties with respect to exposures and effects are mainly an issue for appointed experts in regulatory frameworks, but there are also those who regard this information as essential in public debates.

Some fundamental differences were discerned in attitudes to the possibilities for quantitative and objective information on risks. The

views range from full agreements with claims that all information can be quantified to total disagreement with such claims.

Descriptions of the variability of risks to humans was regarded as more important than those of variability to organisms in general, although human health risks per se were not considered more important than ecological risks of chemicals.

The overall view of the possibilities to deal with complex multiple risks and uncertainties ranged from optimistic to pessimistic. The importance but also the difficulties of integrated risk assessment with respect to, for example, various risk agents, organisms and risks stages were commonly expressed. Integrated information on both risks and benefits of alternative chemicals was considered the most important item by a very large majority of respondents. Many respondents valued highly information on risk reduction, but not that on closer integration of assessment and management.

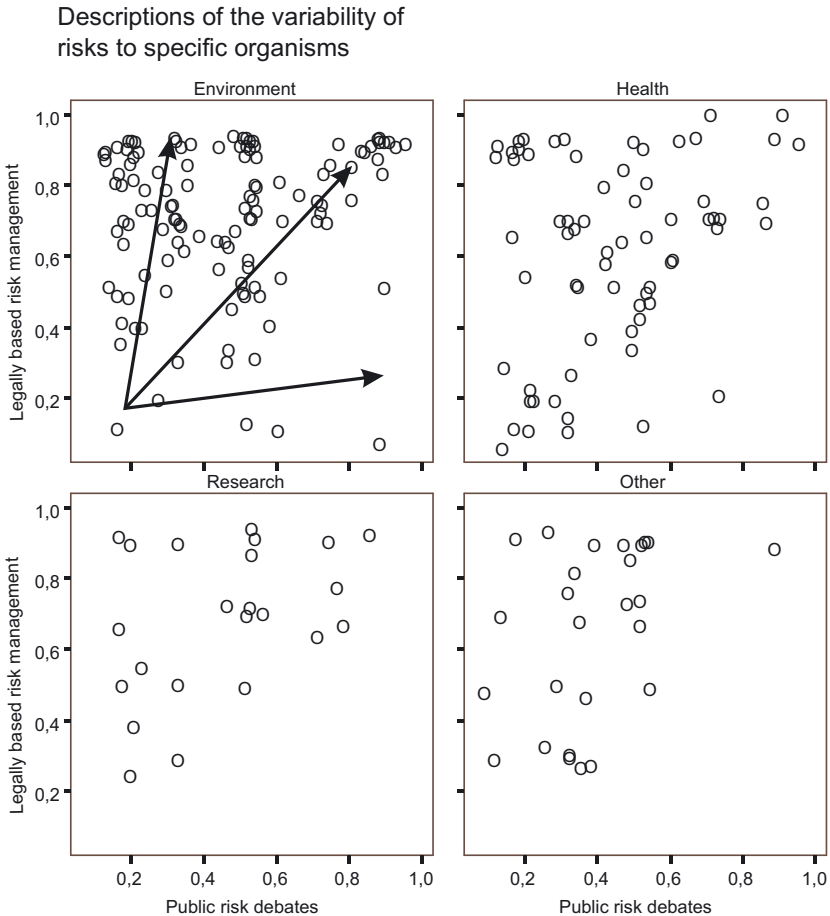


Fig. 1: Typical responses to the 2-dimensional evaluation of information in legally based management and public debates: Scatters of the expressed importance of descriptions of the variability of risks to specific organisms. Note the interpretation of the data points as vectors defined by length (valued information) and direction (type of information use).

Claims regarding risks

The claims regarding risks provided a mix of agreement, disagreement or divided opinions (Fig. 2). They reflect crucial deviations and contrasts in views. There were notable differences concerning philosophical foundations and basic principles of risk assessment and management, such as implications of uncertainty, which could be related also to views regarding the importance of risk information in the previous section. NGO affiliates as the only group strongly disagreed with the notion that risks can be assessed and compared in quantitative terms, while researchers were most strongly of the opinion that risk management should be strictly based on scientific expertise and that risk assessment should be confined to independent experts.

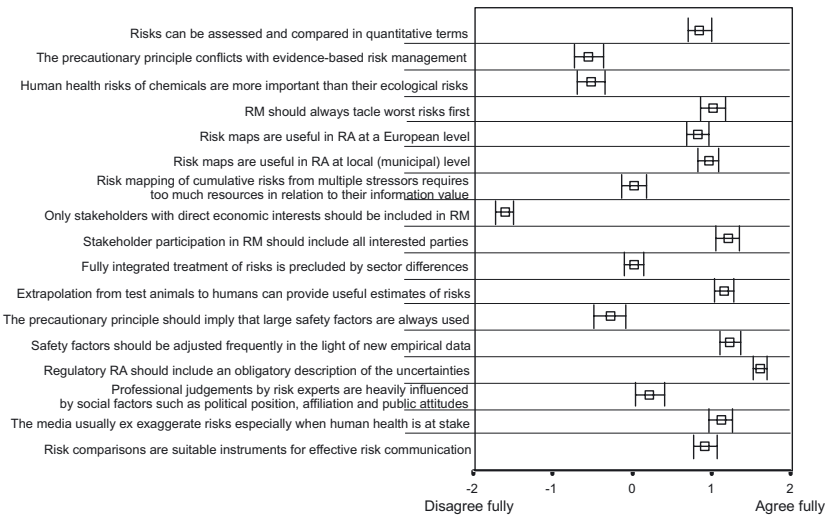


Fig. 2: Level of agreement with selected claims on a scale -2 to 2 in the whole data (means and 95% confidence intervals. RM = risk management, RA = risk assessment).

On some issues the replies from NGOs and industry differed, in others they converged; both disagreed, for example, with the claim that risk assessment could be fully standardized at the European level. Those in international organizations were the most critical toward the notion of full standardization. As to risk communication, it was commonly felt that media tend to exaggerate risks from chemicals especially to human health. Interestingly, relatively few respondents acknowledged that expert judgments are heavily influenced by social factors.

In some cases the degree and direction of agreement could be tentatively explained by background factors, responses to other questions or theoretical models. For example, on average those representing human health expertise tend to stress human risks over ecological risks whereas environmental experts stress ecological risks more. Less expectedly, those from USA and especially international organizations disagreed more than others with the claim that risk assessment should be strictly based on scientific expertise; American respondents were also more skeptical of the idea that the key to dealing with uncertainties is more exact measurements and better validated models, and were more seldom and less strongly of the opinion that most risk controversies are caused by a lack of expert information to the public.

Differences in attitudes concerning the role of scientific evidence may reflect the amount of experience of practical debates on various issues and constraints in risk assessment. Cultural and historical factors may also play a role. Those from new EU member countries seldom felt that professional judgment of experts is heavily influenced by social factors. This may reflect the influence of the history of these countries in which experts often stressed their independent expert role. A similar indication of perceived independence can also be found in the greater confidence that adverse effects of chemicals are not over-represented in literature compared with their benefits. These

observations help to understand the nature of some common controversies or tensions in the development of risk assessment and management.

Risk maps

Risk maps represent novel tools for displaying risks. The possibilities to present risk in the form of maps have been greatly enhanced with the development of information and communication technologies and with the increasing availability of data and background information that includes spatial information. It is therefore of particular interest to analyse both opportunities and potential stumbling blocks regarding the use of maps to transmit information on risk.

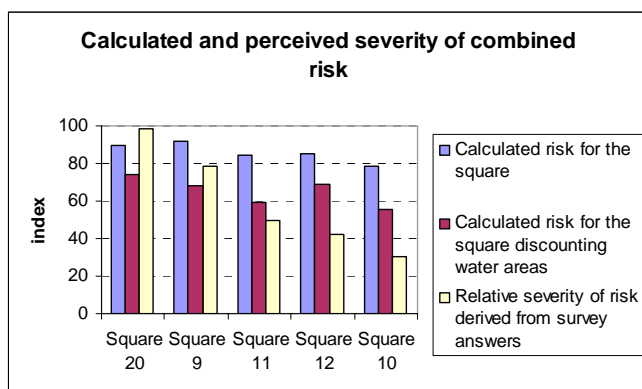


Fig. 3: Correspondence between calculated ('true') rankings of the aggregated eco-toxicological risks to freshwater organisms in example map squares, and the average rankings by respondents for these squares. The calculated risk levels are given as percentages of maximum values either without or with discounting water areas in the squares.

The respondents were generally able to rank risk map grids in consistent order, as compared with calculated risk levels for these grids. This suggests that it is possible to transmit correct impression of the order of risks using maps (Fig. 3). The map integrating three different risks was on the average correctly interpreted as to the order of the two top-risk grids, even better than maps of single risks such as those to algae (Assmuth et al., 2007b). This suggests that the amount of different colours is not a decisive factor. Many respondents nevertheless felt that especially the integrative maps can confuse non-specialists, although they can be interesting and provide a good tool for informing decision makers in particular.

The claim that people should have free access to maps of risks in their own neighbourhood even if the maps can be mis-interpreted divided opinions, with one group seeing this kind of information as something to be limited to the use and interpretations by experts only. This can also reflect the novelty of the method, which may invoke fear of misuse. Unfamiliarity with risk maps may also explain the fact that there was a high proportion of "no position" on the claim that risk mapping of cumulative risks from multiple stressors requires too many resources in relation to their information value. However, such a judgment is also dependent on other interpretations and opinions regarding information value, which may also depend on the use context.

6.2.4 Conclusions on policy and methodological development

The electronic survey as a tool for exploring views on risk

Methodologically, useful experiences were gained of ways to obtain opinions by a web-based survey, but limits e.g. for 'e-Democracy' became clear. Despite a well-tested questionnaire that required only 15 min to fill in, and repeated encouragements, the response rate

remained relatively low. From the survey point of view the main challenge appeared to be the creation of sufficient motivation to click on the link to the survey. Among those who visited the web site of the survey more than half responded to the survey.

Even if one could achieve a high response rate, the complexity of risks and also the controversies and high stakes surrounding them mean that 'real' fundamental views are elusive. Therefore a survey of this kind should be seen mainly as a way of identifying issues and communication topics, but not as a tool for determining quantitatively representative or normative views.

General conclusions of risks views

The survey demonstrates that perceptions and views of risks and uncertainties are genuinely variable. They can be hypothesized to reflect fundamental world-views, such as views of the predictability and benevolence of the world and the ability of humans to control it (cf. Bickerstaff, 2004). For integrated risk assessment in particular, views regarding plurality of both risks and of views are crucial, such as whether plurality is seen as confusing and requiring attempts at uniformity, or as richness to be explored and cultivated. The views of risks and uncertainties can be generally characterized by optimism and pessimism with respect to knowledge (Assmuth et al, 2007a). They cannot however be described with any simple model, and differing conceptions and fundamental ambiguities cannot be wholly dispelled in a mechanistic manner by, for example, additional information. Instead, by respecting the variability and multi-dimensionality of risk perceptions, more meaningful and inclusive concepts and communication of risks and uncertainties are achievable.

The complexity of risks is reflected in the differences of views on many different aspects of risks from the ordering of different risks to appropriate ways of communicating risks. Importantly, the survey demonstrated that there are no simple categories of perceptions and

opinions. Different overall concepts of risks as well as of science, expertise, and society exist also within easily identifiable groups such as administrators, industry and research.

These results have direct bearing on what is meant by, and what can be meaningfully striven at by, 'integrated' risks assessment and 'novel' methods. The results of the survey strongly suggest that attempts to establish normative 'right' views of risks are likely to fail, as there is pronounced variability in perceptions and opinions even among experts. When concepts and techniques are developed one should be aware of the fact that it is virtually impossible to introduce concepts that do not carry a degree of ambiguity (see below).

Implications for addressing uncertainty and ambiguity

A key task of the NoMiracle project is to develop methods for dealing with risks and uncertainties. The survey showed that the experts generally have an optimistic view of science and felt that uncertainties can be reduced through more exact measurement and better validated models. This is consistent with the critical view towards the claim that "The precautionary principle should imply that large safety factors should be always used". However, the acceptance of the claim "Safety factors should be adjusted frequently in the light of new empirical data" by both NGO and industry representatives puts major expectations on the methods.

The assumptions and choices that are used as a basis of safety factors should be made more explicit. This can be one way to reconcile demands for 'precautionary' and 'realistic' safety factors, and for frequent adjustments of safety factors with legal and administrative constraints. It means that also the development processes for safety factors need to be addressed and made as transparent as possible (see next section).

On a more general level, views acknowledging the inherent uncertainty and ambiguity as well as the subjectivity and relativity of risk information were also evident in the responses. These views were

reflected in expressed realization of the challenges posed by complexity of risks and by integrated treatment of risks. A key question becomes how this realization influences assessment and management and the role of scientific advice. The reaction can be either a more inclusive or a narrow concept of science and assessment.

Implications of the results for the development of assessment methods

The fundamental variability in views and perceptions of risks should be taken into account in the development of novel methods for risk assessment, i.e., the overall goal of the NoMiracle project. One should not generally expect that methods of risk assessment are able to deliver generally valid normative results that would be unambiguously understood and accepted. Interpretation is a necessary element in risk management processes and this should be recognised from the outset in methodological development.

The results imply that harmonization and standardization of context-dependent and variable assessments are meaningful to a limited degree only. For integrated assessment in particular, balancing is needed between broadened scope and focus, both in terms of integration across risks (e.g., from chemicals and other agents; to humans and other organisms) and between assessment and management (cf. Assmuth and Hildén, 2006). The varied and divided opinions on the relations of assessment and management suggest that development of assessment methods that would more explicitly incorporate decision factors, also to streamline assessment, is not yet very commonly regarded as important.

A key requirement for methods of risk assessment is that they can deliver information in a form that is amenable to discussions and interpretations. This calls for transparency of the methods and also active communication about their underlying framings, assumptions and interpretations, including implicit value judgments.

Implications for risk communication and support for social learning

The variability in views on risks and risk communication means that there is scope for social learning. Learning does not mean that a full consensus would emerge or that one should have the eradication of differences as a goal. The principal objective is instead to create forums where different groups can learn to understand the views of others more deeply, and possibly also learn to appreciate different views without necessarily accepting them.

The results of the survey indicate that there is a main divide between two types of experts. One group sees risk information, assessment and management as tasks mainly for designated experts who should inform the public but not engage in dialogues with it. The other group considers all issues related to risks to be part of societal processes that therefore need to be debated in public, at the same time recognising assessment and management as formalised processes. These groups are reflected in the disagreement over the claims that "Risk assessment is to be confined to independent experts" and "Risk management should be strictly based on scientific expertise".

Risk communication is difficult to develop in a meaningful way if one sees communication as a one way process of informing the less informed, or as a task of "speaking truth to power" (Renn and Benighaus, 2006). Learning to participate in and to deliver useful material for dialogues is, according to the survey, one of the key challenges for risk experts.

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7 Results of the World Café and discussion in the plenum

By Christina Benighaus

"The terms complexity, uncertainty and ambiguity were well addressed in the Café part of the workshop," commented Peter van den Hazel, member of the advisory board of NoMiracle, in a report about the Open Workshop.

In the late afternoon of the first day a *"World Café"* was organised. *"The World Café"* is an innovative yet simple methodology for hosting conversations about questions that matter. These conversations link and build on each other as people move between groups, cross-pollinate ideas, and discover new insights into the questions or issues that are most important in their life, work, or community. As a process, the World Café can evoke and make visible the collective intelligence of any group, thus increasing people's capacity for effective action in pursuit of common aims (www.theworldcafe.com).

All participants were seated around small tables with about five persons each. In a coffeehouse ambience, they discussed issues of risk communication, like success factors, social and cultural concerns and design of the communication process for chemicals. After 30 minutes the groups were newly mixed. One person remained seated as a host of the table, and he or she greeted four new guests. Every participant had the chance to discuss the issues with new neighbours at the table. The results of the *"Café-Table-Groups"* were intensively debated afterwards in the plenum.

7.1 Key factors in risk communication

One of the issues discussed in the world café were the key factors for a good risk communication such as safety levels, target groups and audience or training needs.

7.1.1 High safety levels but still undesired uncertainty

Living in developed societies has never been as safe as in these days, but nevertheless, and this might be regarded as strange, the demand for realising a higher level of safety is strong. Consequently risk regulators and risk managers experience a strong pressure from the public to improve their handling of risks, including the communication.

A number of factors have led to this situation:

- The role of media has dramatically changed in the last few decades. While news in past years needed a long time to reach the capitals of the world, today it takes, as the example of September 11th demonstrated, only minutes to spread images and commentary around the world and thereby to involve extended populations in a risk experience.
- At present, governments face very low levels of trust.
- In former days people worried about how to feed their own families. These basic needs are now satisfied for most people in the industrialised countries, and people worry about the environment, and about the future and what is going on around them. The more threatening risks are increasingly man-made, and people start to realise this.

7.1.2 Close look at the goals of risk communication

Similar to many other tasks outside the risk sector, a clear view of the goals of risk communication could be helpful to plan actions and to review success after the risk handling process is finished. At one of the Café tables, the participants set up three goals of risk communication:

- Help people to help themselves.
- Help people to prepare their own risk responsibility. They have to be prepared to help themselves to act in a crisis.
- Help people realize that a risk-free society can not exist.

7.1.3 Know the audience and the target group

Risk communication is an ongoing process and consists of learning. Before the risk communicator can set up a communication concept, he needs to know his audience and its requirements.

- Be aware of the audience, of the people to be addressed with the risk issue: what are their concerns, and what might be the dominating risk perception? It is good to know through which media channels the audience prefers to be informed, and who is talking to whom with what level of success (language, amount of information, public and press).
- Build up a relationship to the main target groups. Trust is the source of a good relationship. Use trustworthy sources, and be clear on facts, opinions and values. The relationship with the media could be improved by background talks conducted several times a year. Here, the managers from the industry could inform

the press which incidents had happened and how the company did react. This helps the press to get additional information.

- While discussing risks with specific target groups, be open about what you know, and what you don't know.

With a look at the target group, the risk communication process could be differentiated for the needs of specific target groups

- In general, the public needs understandable scientific data. The participants of this World Café table argued that in a first step the risk communicator should convey concrete messages and try to reach as much of the population as possible with short content information. Relating to the target group, the messages could be less concrete.
- The experts should stick to their own expertise, to the risk topic they are best in.
- The government is not responsible for everything, and governments have a limited scope of action in a risk or a crisis.

7.1.4 Training for risk incidents

The participants collected some experiences and ideas, how the people could be better prepared in a risk incident or crisis:

- Conduct tests on how people might react in an emergency: As a good example, and tested in reality, a truck stopped in a tunnel, and non-toxic smoke came out. The other cars stopped behind the truck. The surprising result was that the people simply stayed in their cars and didn't run back to the tunnel entry. If this had been a real accident, with poisonous smoke, most of them would have died on the spot.
- Conduct exercises with people, and educate people how to react.

- BASF's experiences with risk communication show that it's good to use various types of channels to reach people. They give special information to every home in the community and provide a telephone hotline and guidelines. They try to be absolutely honest, while visiting the people and informing them.
- In the Netherlands, a new campaign has recently started. People can visit a webpage, type in their postal code, and with the help of a geographical information system, they immediately get the type of risks of the area they are living in.

Additionally, before starting the risk communication process, the people in charge should think about how to measure success after the risk process has finished.

7.2 Integration of social and cultural concerns in assessment and management

One question discussed in the world café was the social and cultural concerns of the public.

7.2.1 Be aware of concerns of the public

One of the ideas discussed at one of the World Café tables went into the direction of collecting assumed concerns when starting the risk assessment process. An initial list of social and cultural concerns could be worked out, analysed internally, and then discussed with a group of stakeholders who judge which of the concerns are important, and which could be disregarded. This list of concerns is only to have something in hands right at the starting point of the risk

process. New concerns could come up, others could disappear after a while.

Risk perception questions, and this is interconnected to concern matters, could be integrated into running and regularly conducted surveys. Such monitoring approaches would show changes and dynamics when it comes to risk perception.

Within the normal process of the risk assessment, an additional chapter "*Social and cultural concerns*" could be added.

7.2.2 Adding new tasks to risk regulation is time and cost intensive

The task list to assess and manage risks is already full, and looking at concerns brings even more pressure. Risk regulators are facing limited time, resources and availability, and might worry how to manage additional tasks. People expect to have a quick response to their concerns. All these additional concern assessments cost money, and risk managers have to make do with fewer personnel. Accordingly, it will be a difficult task to integrate the concerns in the main guideline and make them practical.

7.2.3 Distinguish between complexity, uncertainty and ambiguity

Distinguishing between complexity, uncertainty and ambiguity supports the risk management process. If one believes that scientific words can be controversial, complexity could be on a fully abstract and universal level. Uncertainty needs to take the context into account, and depends on context variables. If one looks at ambiguity it

is almost on the individual level, because every person has a different way of interpretation.

7.3 Communication design for chemicals and chemistry

During the plenary discussion of the results of the World Café, moderator Ortwin Renn asked a provocative question: Is there something special about communicating chemical risks, or should the normal procedures be followed?

Things have changed over the past decades. Compared to the 1960/1970s and influenced by some incidents like Seveso and Bhopal, safety matters have improved significantly, and the way risks are communicated are much more sufficient in these days. Nowadays the chemical industry involves stakeholders on various levels.

Chemicals are often perceived negatively in the society, while due to the perceived benefits the reputation of pharmaceuticals – chemicals in itself - is much higher. Chemicals are a very abstract, artificial good, and everybody thinks they could be toxic and harm people. This negative image sticks in the head of most people. Many consumers cannot see a direct association with a useful product. Often they are not aware of the benefits or positive effects. They are suspicious of a substance whenever it is perceived as risky, even if the exposure is harmless.

7.3.1 Communication with the community

Another discussion thread refers how a company should communicate with the local and regional community. Risk communication -as a general leitmotiv -

- should contain adequate and sufficient data on chemicals provided by the chemical company, and
- the way of getting in contact with the local people should be open and transparent.

First the general frame of the issue has to be analysed. Basic questions have to be answered before starting a risk communication process, like the type of risk, what happened, who is talking to whom. But the main challenge is fixing the objective. The risk manager should be very clear about the objectives relating to the target group while communicating a risk or a crisis.

Regaining confidence is seen as difficult. One of the positive examples in which trust is the basis and the starting point of the communication process comes from Japan. A company announces the temperature of their emissions directly at the chimney. They just show that the temperature is high enough that all dioxins are destroyed when the emissions are being blown out.

The chemical company BASF has set up some measures to get in contact with the local community:

- Round table discussion every three months in the community
- Mobile ambient pollution exposure assessment, mobile station, measuring the air pollution
- Brochures for the population on produced chemicals

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- Testing of all relevant endpoints of produced chemicals based on up-to-date knowledge
 - Scientists working at BASF for product safety
 - Technical dossiers with important properties of substances available for public
 - Open-door events once a year
 - Excursions for interested persons to visit plants
 - Telephone information 24 h per day

The participants suggested setting up educational training for adults, but in schools as well, to change the behaviour and attitude relating to risks. The public could gain awareness that a zero-risk simply cannot exist, and view the benefits of chemicals in a well-balanced matter.

The NoMiracle project wants to empower managers through providing better methods to identify, assess, and ultimately manage risks. Communication with the community would be to enable people to participate in evaluation of risk, and assessment of their own behaviour as they keep the safety level they want to keep.

7.3.2 Risk Comparisons as a communication method

Risk comparisons are seen controversial in the plenary. On the one hand comparing risks in the right way demonstrates of how risky a substance is in reality and puts probabilities in another perspective, but one has to be careful. Risk managers should always compare risks that are in the same class, to avoid mistrust and anger on the side of the target group.

In Spain, and that seems to be typical in this country, the local households in neighbourhood of a power plant get free energy. Industry could therefore start trust-building measures, and effectively show they are caring for safety. This example shows that people are offered a substantial monetary benefit in change for accepting a long term risk.

A very practical tool was presented from the Netherlands: In some schools, the classrooms are fitted with sensors for indoor air pollution. The sensor goes to red if the CO₂ is too high, and teachers are prompted to open the windows.

7.3.3 Overcoming detaining factors for communicating chemical risks

The “basic rules of risk communication have never been changed”, one participant stated during the plenary discussion after the World Café, and this is true for chemicals as well. However, the participants brought up many other factors which affect risk communication in

the chemical sector and make it special compared to other risk sources:

1. **Unfamiliarity:** Ordinary persons are not familiar with chemicals and can't see the benefits as clearly as the risks. Better educational programmes, for people of all ages, would help to overcome this factor.
2. **Artificiality:** Chemicals are perceived as artificial, no matter which specific substance is involved. Similarly to the case of factor 1, teaching and informing would be likely to raise the level of acceptance.
3. **Involuntariness:** People face a lack of personal control and have the feeling of being exposed to chemicals involuntarily. In order to weaken this factor, more involvement of people in appropriate risk assessment steps is essential.
4. **Collective memory:** Collective memory of incidents in the chemical field is very salient. Risk managers could handle this actively and show people how risk assessment and safety procedures have improved over the years.
5. **Negative reputation:** Chemistry and chemicals hold a negative reputation associated with a lack of trust in managers. Here participation is needed to build up societal trust in the assessment and regulatory procedures.

8 Learning from other EU-Projects: case studies

“The participation of the coordinators of other EU-projects was a good initiative and increases the visibility of NoMiracle in Europe,” said Peter van den Hazel (member of the advisory board of NoMiracle project).

In three case studies the project partner of the similar EU-project STARC (Stakeholders and Risk Communication), PHIME (Public health impact of long-term, low-level mixed element exposure in susceptible populations strata) and SAFE FOODS gave ideas and valuable hints how risk communication to and with stakeholders in the complex topic of cumulative risks could be realised in the NoMiracle project.

8.1 Case study 1: The STARC project: Stakeholders and risk communication

By David Wright & Yves Dien

The project Stakeholders and Risk Communication (STARC) was funded under the European Commission’s Sixth Framework Programme “to promote co-ordination of national approaches on risk communication and to propose initiatives for involving all stake-

holders and civil society in a more dynamic risk governance culture". The project began in June 2005 and concluded in January 2007.

The STARC consortium comprises researchers from Electricité de France (EDF), Trilateral Research & Consulting (UK), the South German Institute of Empirical Social Research (SINE e.V.), INERIS (Institut National de l'Environnement Industriel et des Risques, France), the International Risk Governance Council (IRGC, Switzerland) and the Institute for the Protection and Security of Citizens (IPSC) of the European Commission's Joint Research Centre (JRC, Italy).

The STARC consortium had several tasks:

- to examine the dimensions of risk communication,
- to conduct a survey of the Member States and selected other countries in order to examine the actual practice of risk communication,
- to conduct a series of in-depth interview in three industries in four countries,
- to identify good practices,
- to conduct a workshop of risk communication experts and
- to make recommendations to the European Commission and others.

8.1.1 Six Dimensions

Risk communication has many dimensions, among which the consortium focused on the following:

- the strategic dimension,
- the information dimension,

- trust and uncertainty,
- the operational dimension,
- the media,
- the institutional dimension.

8.1.1.1 The strategic dimension

Strategies comprise or are built from several elements, including a set of objectives, a game plan with actions and the resources necessary to achieve those objectives. A good strategy will include provision for monitoring progress, making adjustments if necessary and learning lessons.

The strategic dimension is underpinned by principles of good governance, which the Commission has identified as openness, participation, accountability, effectiveness and coherence, together with proportionality and subsidiarity. These principles not only stress the participation of stakeholders “throughout the policy chain – from conception to implementation”, but also the use of language that is “accessible and understandable for the general public”.

Like the other dimensions of risk communication, the strategic dimension provided a basis for developing the questions on actual practice that the STARC partners put to countries and industry sectors.

8.1.1.2 Perception, trust and uncertainty

The STARC consortium reviewed various studies, approaches and projects dealing with risk perception. The bottom line, however, is

that risk managers and policy-makers must have a good “feel” for how stakeholders, including the public, perceive risks, which they regard as important, what their concerns are and what factors shape their concerns, behaviours and values.

Hence, the risk manager must employ methods and commit resources to ensure that some stakeholders interested in or affected by a risk are not marginalised in the policy-making process. Surveying stakeholders, including the public, can help to build trust in risk communication. If there is no trust among stakeholders, risk communication is bound to fail.

Differences in the level of trust among stakeholders are another reason why risk communicators must target different stakeholder groups with information tailored as far as possible to meet their needs using channels most likely to reach them.

At the same time, in any participatory exercise, it behoves the risk communicator to ensure that the same rules apply to everyone, that the process for establishing those rules is transparent.

Risks, by their very nature, are uncertain. As the level of uncertainty goes up, the level of trust stakeholders are willing to extend to the risk manager goes down. Thus, risk communicators must acknowledge and make transparent the very fact that cases of scientific ignorance are not the rare exception, but the norm. To acknowledge gaps in knowledge and existing uncertainties, therefore, is a fundamental precondition for adequate risk communication. The question confronting society – and the risk manager – is what degree of uncertainty is deemed acceptable.

8.1.1.3 The information dimension

The content of messages, the way in which that content is conveyed, who is doing the conveying, understanding how the messages may be received and perceived, the credibility of spokesmen and so on are all important to achieve success in risk communication.

The STARC partners concluded that, as a matter of good practice in risk communication, it is important to collect and evaluate empirical information obtained through surveys, focus groups or interviews about stakeholder judgements of each of the perception factors (control, benefits, trust, etc.).

8.1.1.4 The operational dimension

Unless the risk manager meets face to face with stakeholders, risk communication will depend on some physical means of communications, e.g., landline telecom networks, satellite communications, cellular radio, HF and VHF, TV and radio broadcasting, the Internet, etc. The STARC consortium termed this the operational dimension of risk communication. Such physical networks have been little considered by risk managers, although those engaged in emergency communication are much more conscious of their importance. Nevertheless, the operational dimension is an important factor to take into account in risk management since networks' availability, or limitations, may affect risk management options.

Our review of the operational dimension led us to include in our survey and interviews of actual practice questions about whether risk managers and civil protection authorities had plans for communicating with stakeholders, including the public, in the event of a catastro-

phic failure of the existing telecom networks and alternative means they might employ.

8.1.1.5 The media dimension

Journalists tend to treat risk issues differently from the way technical and scientific people do. Thus, some conflict between risk communicators and journalists and other intermediaries is inevitable and should be expected. Nevertheless, the risk of conflict and bad press can be reduced if risk communicators have a good understanding of the media, the risks inherent in communications with the media and what steps they should take to minimise those risks, to meet the practical requirements of the media in an emergency and to develop a working relationship where there is recognition that the goals of the media and the risk communicator do sometimes coincide.

8.1.1.6 The institutional dimension

At the European level, there is no explicit risk communication legislation as such, but there are numerous treaties, conventions, directives, communications and policies relevant to risk communication, which provide a kind of framework or context for the practice of risk communication.

The STARC consortium surveyed and interviewed representatives from the Member States and selected industry sectors about their practice of risk communication. In particular, we were wanted to know whether there are any legislative or regulatory requirements at national level for communicating with the public about risks, for co-ordination of risk communication between the public and private sectors, when risk communication starts in the risk management

process, whether there are provisions for identifying and seeking the views of all stakeholders, making public comments received from stakeholders, co-ordinating risk communication with other countries, surveying public perceptions of risk and so on.

8.1.2 Actual practice – a survey and in-depth interviews

The consortium undertook a survey of EU Member States and selected other countries to examine actual practice of risk communication. In addition to the survey, the consortium conducted in-depth interviews with representatives from the nuclear power, chemical waste and genetically modified foods sectors in France, Germany, Hungary and Switzerland.

The consortium e-mailed a questionnaire to the civil protection authorities in each of the EU 25 Member States and six other countries, namely, Australia, Canada, Japan, Norway, Switzerland and the United States, in December 2005. Numerous follow-up telephone calls were made so that eventually the consortium had responses from 28 countries.

The principal findings of the survey are summarised as follows:

- Two-thirds of countries surveyed reported that they have legislative or regulatory requirements for communicating with the public about risks, but a majority of countries do not require companies who offer shares to the public to make public information regarding the risks they face and how they manage those risks.

- When risk communication begins in the risk management process varies significantly. For about half, it begins before or at the risk assessment stage. In the other half, it begins after this stage.
- In more than half of the countries, surveys are conducted to assess the public's perception and/or prioritisation of risk although the frequency of such survey varied significantly (in one case by up to 10 years).
- Most countries provide stakeholders and/or the public with feedback regarding the extent to which their views have been taken into account.
- For a wide majority of countries, risk communication provisions exist as part of the risk management plans (versus separate, stand-alone documents). Most risk communication plans contain provisions for identifying stakeholders and civil society organisations (CSOs). Almost all countries responded that they welcome the views of stakeholders and CSOs; however, few countries make public comments from stakeholders.
- Risk communication is not an "isolated" activity. About half of the countries co-ordinate their risk communication, at least to some extent, with the different levels of government (national, regional, local), "risky" industries and/or neighbouring or other countries.
- In most countries, the government provides advice (e.g., via the web or other means) to the public about what they should do if a risk event occurs. In half of the countries, the national risk communication plan contains provisions about how the information should or could be conveyed. Few such plans say whom to contact for more information.

As a conclusion, one can see that the risk communication issue is addressed in a majority of the countries surveyed, but there are significant differences in policy and practices.

8.1.3 Good practices

From the responses to the risk communication questionnaire, the STARC partners drew a number of conclusions and identified good practices, among which the following are a sample:

The consortium agreed with Canada that it is a good practice to regard risk communication as a continuum (or as a cycle) in which emergency and crisis communications should be a part.

Based on the results of the survey, it appears that a majority of countries do not require companies listed on a stock exchange to include in their annual reports a risk assessment and how they are managing risks. The consortium thinks, as a matter of good practice, there should be such a requirement.

Most respondents said that their risk management plans do refer to risk communication, and the consortium regards this as a good practice. However, there would be value in separate, generic risk communication plans or guidelines, as in the UK and a few other countries, which would avoid the need for risk managers and risk communicators to “re-invent the wheel” for every separate risk management strategy.

In the consortium’s view, good practice favours risk communication beginning at the pre-assessment / assessment stage, since stakeholders, including the public, may bring information that might not otherwise come to light from the experts, and stakeholders will certainly bring their values and opinions, which may well be different from those of the experts and/or risk manager.

Stakeholders or stakeholder groups should be identified in as fine-grained detail as possible and their participation encouraged in the risk management process for all types of risks.

The consortium regards co-ordination of risk communication between the private and public sectors as good practice, so long as it is not an instance of regulatory capture. The Seveso II directive provides a model for good practice with regard to such co-ordination.

Countries should co-ordinate their risk communications, not only horizontally with other government departments and vertically with other levels of government, but also with stakeholders and with neighbouring countries.

Regular government surveys of stakeholders' perceptions of risks are a good practice. Such surveys will help inform risk managers as well as stakeholders about how their fellow citizens and groups of citizens perceive risks, and the relative importance they attach to risks. It would be good practice to publish the results of such surveys.

Although most countries recognise the need to provide information to stakeholders about existing and emerging risks, many provide little opportunity for stakeholders to contribute to and participate in the risk assessment – risk management process, especially starting from the “pre-assessment” or horizon-scanning stage. Nor is it sufficient for risk managers and policy-makers to simply give stakeholders an opportunity to participate. Risk managers should proactively *identify* stakeholders and the publics (plural) potentially affected by or interested in a risk and contact and encourage them to participate. If some stakeholder groups are unable to participate because they lack the time, resources or expertise, they may need to be

assisted. Failing that, as a minimum, at least some survey or representative sampling should be made in order that their views are taken into account. There are various representative and participatory mechanisms that could also be employed to ensure as adequate a cross-section of views as possible.

The public should be satisfied that their views have been considered and taken into account, even if their views or their information have not been decisive in the choice of the risk management option eventually chosen.

8.1.4 Conclusions and recommendations

It was not much of a surprise that there are wide differences in the practice of risk communication across the Member States as well as the selected other countries and industries. Hence, the consortium's final report provides a set of good practices based on the research, survey and interviews conducted during the project.

The final report makes two key recommendations:

- that the European Commission take the initiative to convene a meeting of risk and crisis communication experts from the Member States the purpose of which would be to exchange views on good practice in risk (and crisis) communication, consultation and co-ordination. The meeting could also consider good practice in conducting exercises, lessons learned from case studies of risk communication (dealing with real risk events) and scenarios (given a particular risk event, what would be an appropriate risk communication strategy). The meeting could also consider the extent to which there are differences in risk communication practice between different risk domains and between government and in-

dustry and whether good practices in one domain might usefully be adopted in other domains.

- that the Member States develop and implement a risk communication policy complemented by guidelines.

The STARC recommendations are simple, straight-forward and (we believe) easy to implement. If the Commission were to take them on-board, the consortium believes their implementation would be an important step towards bridging the gap between the theory and actual practice of risk communication. It could also be a way to harmonise such practice without requiring legislation.

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The views expressed in this paper are those of the authors alone and are in no way to be interpreted as reflecting those of the European Commission.

8.2 Case study 2: Risk communication aspects in the EU project PHIME

By Staffan Skerfving

8.2.1 The PHIME project

The project PHIME (Public health impact of long-term, low-level mixed element exposure in susceptible populations strata) is an integrated project within the European Union's Sixth Framework Programme (FP6), in the area Food quality and safety. It has been merged with PHIMETTC (Targeted Third Countries).

The project will run during the period 25 February, 2006 to 2011. This means that the project is not yet half-way, and that the main activities presently are establishment of studies and collection of data. Hence, data processing and reporting have not really advanced far, and risk communication still lies in the future. Still, already at this stage, several risk communication aspects can be foreseen.

The EU budget is 13.4 MEUR. But since the participating research groups contribute with other funding, the total budget is considerably larger.

The project involves 34 partners in 22 countries, with 14 EU Member States and eight others (Croatia, Switzerland, Faroe Islands, USA, Seyshelles, Bangladesh, China, Ecuador and Morocco).

PHIME involves about 100 scientists, of whom only one is a social scientist (though a project manager).

8.2.2 Main objectives

A. What are the problems? Pillars I and II.

B. Where are the problems? Pillar III.

C. Possible solutions of the problems (some). Pillar IV deals with the uptake and distribution of toxic and essential elements in plants, with the objective to generate plants which accumulate less of toxic and more of essential (selenium, zink, copper) elements.

The four PHIME Pillars contain 39 workpackages (30 "vertical" and nine "horizontal=cross-cutting" ones).

"Public health impact..."

Pillar I deals with the nervous system. The pillar coordinator is Marie Vahter, Stockholm. Main problems are effects of methylmercury, arsenic and manganese on the central nervous system (CNS) of fetuses and young infants. In particular, effects on cognitive functions CNS are dealt with. But in addition, the possibility that prenatal exposure to methylmercury may cause Parkinson's disease later in life is scrutinized.

Further, Pillar I studies toxic effects of manganese on the adult CNS, in particular development of Parkinson's disease. Also, the effects of elemental mercury on the adult CNS will be studied, in particular in relation to genetic mechanisms of action.

In Pillar II (pillar coordinator Alfred Bernard, Brussels), effects of toxic metals on the kidney will be studied. In particular, toxicity of mixed exposure to several elements on the kidneys of teenagers and adults will be assessed. Further, the possibility that cadmium, lead and mercury may induce end-stage renal disease (uremia) in subjects in the general population is addressed. Also, the possibility that these elements may cause diabetes is studied.

Moreover, Pillar II has a subpillar (coordinator Karin Broberg, Lund) on cardio- and cerebrovascular disease. In that, acute myocardial infarction due to exposure to mercury is studied, as well as a possible impact of prenatal methylmercury exposure on later risk for myocardial infarction.

A third subpillar (coordinator Agneta Åkesson, Stockholm) addresses effects on the skeleton (osteoporosis and fractures) by cadmium exposure.

..."long-term, low-level"...

PHIME will focus upon the exposure intensity at the levels, which occurs in the general population. Occupational exposure will be studied only when it may be used as a model to illustrate mechanisms of action.

In Pillar III (coordinator Ingvar Bergdahl, Umeå), PHIME will survey the exposure to toxic elements (lead, mercury, cadmium, as well as the "automobile catalytic converter elements" platinum, palladium and rhodium) in a long series of countries, with particular emphasis on Eastern Europe. In particular, children and young and elderly women will be included.

The PHIME data will thus give a picture of the geography of exposure, showing differences in exposure patterns. Also, the studies will establish a basis for time trends of exposure, an area for which there is surprisingly little information (with the exception of lead).

..."mixed elements"...

As indicated above, PHIME will address a series of toxic elements (mercury, lead, cadmium, arsenic, manganese, platinum, palladium and rhodium).

In addition, several essential elements will be studied (selenium, zinc, copper and calcium), in particular as regards interactions with the toxic ones.

..."susceptible population strata"...

The focus in PHIME is on the most sensitive parts of the population. Especially, fetuses, infants and children are included, since they are often the critical part of the population, which first suffer from toxic effects.

In addition, fertile women are studied, since exposure before and during pregnancy will affect fetuses, and lactation will mean intake of toxic elements in the breast-fed infant.

PHIME will also assess other aspects of susceptibility to toxic elements, for example because of nutritional deficiencies. Hence, women are sometimes particularly exposed, because they often have a low iron status, which may mean high absorption and retention of some elements, for example cadmium. Hence, elderly women will be studied.

A further main area is gene-environment interaction. Thus, the interaction between a series of genes with the toxic elements mercury, manganese and cadmium will be assessed, for example effects on the toxicokinetics and toxicodynamics, including protection against oxidative stress.

Non-elemental factors

Several other non-metal pollutants may interact with the toxic elements. Hence, persistent organic pollutants (POPs), such as polychlorinated organic biphenyls (PCBs) and DDT affect the fetal brain and the skeleton, and may thus interact with methylmercury and cadmium, respectively.

Further, the mycotoxin ochratoxin A, which is widely distributed in foods in several parts of the world, is nephrotoxic, which opens a possibility of interaction with nephrotoxic metals, such as cadmium, lead and mercury.

Further, as indicated above, PHIME will also assess aspects of nutrition, with particular emphasis on the interaction with toxic metals. For example, the possibility that intake of selenium and long-chain polyunsaturated n-3 fatty acids (PUFAs), on the one hand, and methylmercury, on the other, will interact with respect to effects on the fetal and adult brain, as well as the heart. Also, impact of other nutrients, such as vitamins and choline, will be addressed.

"Horizontal=cross-sectional" activities, including risk communication

PHIME has nine workpackages linking together the activities in the four pillars. Examples are gene-environment interaction, risk assessment modelling and "nutritox".

One important activity is, and in particular will be, dissemination (workpackage leader Dale Sander, York), including risk communication. The communication targets will include EU (DG SANCO; DG ENVIRONMENT, European Food Safety Authority; European Environmental Agency), national governmental and regional agencies (in which many of the PHIME scientists are scientific advisors), stakeholders, mass media and the public.

PHIME itself has only a limited ambition in the risk communication area. Hence, the project has a great interest of close interaction with other EU projects, which has a greater focus and resources for risk communication, such as NoMiracle.

PHIME will encounter several complicated risk communication problems. In the following, a few examples will be given, to illustrate different aspects.

8.2.3 Examples

Example 1: Cereal fibers and cadmium

Cereals are a main source of cadmium in the general population. Accordingly, vegetarians are more cadmium exposed than other populations strata.

In particular, cadmium is present in whole grain cereals, which is the origin of cereal fibre. Such fibre is beneficial for the function of the gastro-intestinal tract, promoting the motion of the gut and inhibiting the effect of carcinogens. Further, the fibre content of the diet seems

to counteract the metabolic syndrome and diabetes, thus improving cardiovascular health.

There are indications that the cadmium exposure in the general population is sufficiently high to induce toxic effects in susceptible strata. In particular women, who - as said above - because of the high prevalence of iron deficiency, have a particular tendency to retain cadmium in their kidneys, have slight toxic effects on the kidney tubuli, and also discrete effects on their skeleton, probably as a result of the kidney damage (with deficient activation of vitamin D and urinary loss of calcium), possibly also because of a direct effect on the bone cell. As said above, objectives of PHIME is to find out whether this also means increased risks of end-stage renal disease and osteoporotic fractures.

Thus, there is a risk communication problem. How should the balance between risk of cadmium and benefit of fibre be described to the risk managers, the mass media and the general public.

At the same time, PHIME will generate information on how to reduce the cadmium content of cereals, which means a potential for the risk managers to reduce the cadmium exposure, though this will take time. Even more distant - several decades - is the possible impact of the information, which will be generated within PHIME, to persuade the risk managers to enforce reduction of cadmium pollution, which will gradually decrease the cadmium content in the agricultural soil.

Example 2: Mercury, PUFAs, fetal brain damage and myocardial infarction

Fish is a main source of exposure to mercury in the general population. In many areas, the methylmercury levels in fish are high, in lakes,

rivers and coastal waters as a result of local contamination from mainly industries. But large predatory fish in the oceans, such as tuna, shark, halibut and swordfish, may also contain high concentrations, as a result of global pollution and natural sources. Many general populations in different parts of the world have a high exposure to methylmercury.

Methylmercury is completely absorbed from fish. It passes the placenta barrier and accumulates in the fetus, which only has a limited ability to eliminate the compound. The methylmercury passes the blood-brain barrier, and may disturb the development of the brain. One of the objectives of PHIME is to define the exposure-response relationship for this effect.

At the same time, fish is the major source of PUFAs. There is fairly strong data indicating a favourable effect of intake of fish and PUFAs during pregnancy on the IQ of children. Hence, with respect to the fetal brain, there are two counteracting agents in fish: methylmercury means a risk, while PUFAs are beneficial. In addition, fish is an important source of selenium, which may also be beneficial.

There are also indications that methylmercury may induce atherosclerosis, probably through formation of free radicals with lipid peroxidation. This may lead to myocardial infarction, a problem which will be studied within PHIME.

But simultaneously, the PUFAs from fish protect the heart from death from myocardial infarction, probably by reducing the risk of arrhythmias, possibly also by reducing serum levels of cholesterol and triglycerides. There are also indications that selenium - of which fish is also an important source - reduces the infarction risk. Hence, again, the same seafood may contribute both deleterious and beneficial factors. Variation of the balance between these factors may differ be-

tween various fish species and fish from different areas, may explain why published studies have indicated conflicting relationships between fish intake, mercury, PUFAs and selenium, on the one hand, and myocardial infarction, on the other (**Figure**). To further entangle this is a major aim of PHIME.

It may already now be foreseen that there is a major risk-communication problem in the areas of brain development in the fetus, as well as myocardial infarction in the adult, in relation to intake of fish containing varying concentrations of methylmercury, PUFAs and selenium. How can we communicate information aiming at protection of the brain and heart from the negative effect of methylmercury, while we simultaneously make the population benefit from the PUFAs and selenium? If we warn fertile women, we may cause a reduction of the fish intake, which may result in lack of the positive effects for the fetus and the adult subject, including the whole family. This needs careful considerations, and a need of accurate risk-benefit analysis of effects on the different scales, which is an undeveloped area.

Example 3: Arsenic and manganese vs. CNS, kidney and skin damage

Drinking water in different areas of the world contains high concentration of arsenic and manganese. In particular, the drilling of deep wells in Bangladesh, to prevent prevalent deaths from gastrointestinal disease in weanling infants, as a result of microbial infections from surface water, has resulted in high concentrations of arsenic and/or manganese in the non-infected ground-derived drinking water from millions of wells.

But arsenic and manganese intake in the pregnant woman may result in toxic effects on the CNS of the fetus, which will result in retarded

cognitive development. Further, the elements may cause kidney damage and skin lesions, including keratosis and cancer. These problems will be studied in detail within PHIME.

Hence, we will again encounter a risk-communication problem. How can the risk manager reduce the risk for the brain, kidney and skin, while at the same time avoiding the major risk of gastrointestinal death in infants? One particularly problematic communication aspect is that the toxic effects are subtle - a reduction of the IQ by a few units will not be noted by the parents (though a disaster for the community) - and/or long-term - the effect on the kidney and skin will only appear after years, *versus* the almost immediate, obvious risk of death by the infants.

There are several possibilities, but they have all serious drawbacks: There is a large variation in the concentration of toxicants between wells. Hence, closing of contaminated wells may be employed, but that would mean either carrying of water from other, non-contaminated wells, which is troublesome for the parent, or building of pipelines, which is very expensive. Alternatively, water filters may be installed, which is also complicated and expensive, in particular considering the enormous number of wells. Thus, risk communication to the risk managers and to the general public is not an easy task.

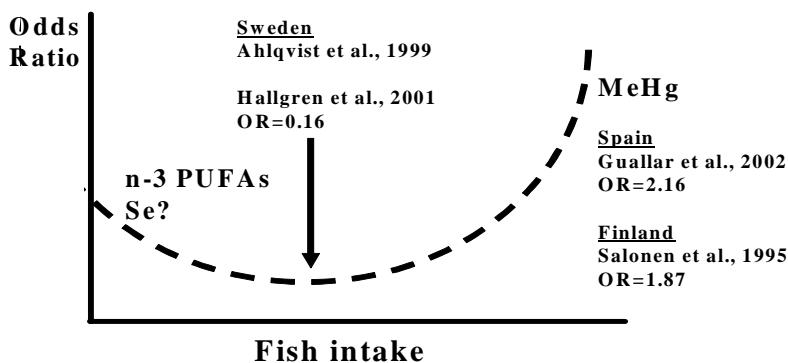


Fig. 1: Hypothetical relationship between fish intake and risk (Odds Ratio=OR) of acute myocardial infarction in different epidemiological studies, with indication of possible responsible deleterious and beneficial agents supplied by the fish, which may explain the varying risks. n-3 PUFAs = long-chain polyunsaturated n-3 fatty acids; Se = selenium; MeHg = methylmercury.

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8.3 Case study 3: Towards an Inclusive Governance of Food Safety in Europe

By Marion Dreyer

8.3.1 Introduction

Food safety policy in Europe is currently particularly interesting as a field of empirical risk research as it is striving to revise the rules and routines of the governance of food risks. At the EU-level and also in some of the EU Member States the overarching objective of this reform process is to restore what is perceived as a most valuable, however, scarce resource: *public trust* in food safety and those responsible for protecting the food supply and consumer safety.

One of the major governance measures designed to remedy the deficit of public trust is *wider public consultation* in the process of regulating food safety risks. At EU-level, declarations of the value of and the need for ‘connecting with citizens and stakeholders’, ‘open dialogue’, and ‘understanding and addressing the concerns of stakeholders and consumers’ now represent a standard part of the official rhetoric. The most significant structural innovations in this respect is possibly the setting up of stakeholder fora with the mandate to consult that institution which is responsible for providing independent, high quality scientific advice, the authority for risk assessment (the European Food Safety Authority, EFSA).

At the same time wider stakeholder involvement in food safety governance is also a highly disputed issue. Major questions raised by practitioners and academics alike include: At which stages should involvement of so-called 'interested and affected parties' reasonably occur? How is the stakeholder policy of EFSA compatible with the declared aim of safeguarding the independence of assessment by keeping it separate and free from influences by non-scientific considerations? How to feed the relevant resources of social groups and possibly also the wider public into the process without an overkill of participatory procedures that would abuse the scarce resources of both the responsible institutions and actors of the 'outside world'?

The fifth subproject of the EU-funded SAFE FOODS project has developed a proposal for how to design and put into practice a more structured approach to stakeholder and public involvement which seeks to address these issues¹. The following sections provide an outline of this approach.

¹ The present paper draws on an interim report which was recently produced within this subproject (so-called work package 5) of the SAFE FOODS project: M. Dreyer *et al.*, *A General Framework for the Precautionary and Inclusive Governance of Food Safety*, Interim Report of WP5 of SAFE FOODS, DIALOGIK, Stuttgart, 4 May 2007, and in particular on Chapter 8 by M. Dreyer and O. Renn, 'A Structured Approach to Participation', p. 90-97. The SAFE FOODS Integrated Project is funded by the European Commission under the 6th Framework Programme and coordinated by Harry Kuiper and Hans Marvin at RIKILT (Institute of Food Safety) in the Netherlands.

8.3.2 Towards a structured approach to participation

Stage- and purpose-specific participation

A recent publication on the role of expert advice in the governance of science and technology states rightly that “*public engagement is not a stage of governance that can be completed, tidied up and filed away*”². Instead, public engagement should be understood as an inherent element of the whole process of governance and would raise the more exigent question of how to incorporate the perspectives and specialized knowledge of interested and affected parties early and meaningfully into the process.

One way in which to address this question in a first step is to distinguish between *different purposes* of participation which are served at the different stages of the governance process. We propose to distinguish four essential stages of governance: assessment and management as the two well-established components of risk analysis, and two additional stages: firstly, *framing* which encompasses the definition of the respective problem and the setting of the terms of reference for assessment, and secondly, *evaluation* which relates to the process of assimilating and deliberating upon the outputs of the assessment phase and considering the tolerability or acceptability of a given food safety threat more explicitly³.

² J. Stilgoe, A. Irwin and K. Jones, *The Challenge is to Embrace Different Forms of Expertise, to View them as a Resource rather than a Burden... The Received Wisdom. Opening up Expert Advice*, London, Demos, 2006, p. 53.

³ The four-stage structure draws on the Integrative Approach to Risk Governance advocated by the International Risk Governance Council; see: O. Renn, *White Paper on Risk Governance. Towards an Integrative Approach*, Geneva, International Risk Governance Council, 2005.

Advocating the addition of these two stages is not to claim to propose something entirely new. Also in the current food safety governance system framing and evaluation activities are carried out, inevitably, so to speak. However, these activities are carried out in a manner which is little transparent. The step of evaluation is moreover exercised in a manner which is largely implicit and ad-hoc, and responsibilities are not clear: Is evaluation a task carried out/to be carried out by assessors or by managers or by both?

The key feature of framing and evaluation is that they constitute *interfaces* between the assessment stage, which is focused on knowledge generation and collection, and the management stage, which is focused on value-laden decision-making in a jigsaw puzzle of facts, uncertainties, stakeholder interests, and public concerns. They are interface tasks in so far as they draw on *both* scientific knowledge and political and socio-economic considerations: The tasks of framing need to be governed by societal values (stating the goals, objectives and contextual conditions) and inspired by what we already know about the threat (suspected impacts, exposure, persistence, and others). Similarly, during the phase of evaluation, the tolerability/ acceptability judgement requires a good understanding of the web of evidence, residual uncertainties, and ignorance (i.e. of the scientific characterization of the threat) as well as a judgmental competence for making the necessary trade-offs between risk, benefits and other relevant impact categories. In that sense, framing and evaluation are so-to-speak 'hybrid' activities. The proposed formalisation of these two activities as governance stages in their own right is a way to account for the inherent inter-linkages between the scientific and political aspects of food safety governance (which are in the current governance system often obscure and lie outwith the view of democratic accountability) and at the same time to not compromise the functional differentiation between assessment and management activities (as provided for in the General Food Law).

The proposed four-stage-structure of food safety governance avoids on the one hand the naïve decisionistic separation in values here and

facts there, and at the same time escapes post-modern relativism in its extreme version by honouring the analytical distinctions between the factual and the desirable world even if they clearly interact. That way, the four-stage structure has potential to create more *accountability* by enhancing clarity over the nature of the reasoning underlying governance outcomes, in particular over the way in which knowledge and value inputs relate to management decisions. Moreover, the formalisation of the stages of framing and evaluation improves political and public accountability by clarification of the responsibilities for essential governance activities.

In order to define the different purposes of participation served at the four governance stages we propose to distinguish between *four discourse categories*: a design discourse (generic to the framing stage); an epistemic discourse (generic to the assessment stage); a reflective discourse (generic to the evaluation stage); and a practical discourse (generic to the management stage)⁴. The following paragraphs provide a brief description of the four discourses and the role participation takes in them:

Participation at the stage of framing means involvement at the earliest stage of governance. Participation is here about contributing to a *design discourse*. This discourse is aimed at setting the terms of reference including the scope, focus and design of assessment and at specifying the way (breadth, concrete procedures) in which stakeholders and/or the wider public are included in the assessment process.

The *epistemic discourse* at the stage of assessment comprises communication processes, where experts of knowledge (not necessarily scientists) grapple with the clarification of a factual issue. The goal of such

⁴ The labels for these different discourse types were first introduced by O. Renn, 'Diskursive Verfahren der Technikfolgenabschätzung', in: T. Petermann and R. Coenen (eds.), *Technikfolgenabschätzung in Deutschland. Bilanz und Perspektiven*, Frankfurt/M., Campus, 1999, p. 115-130.

a discourse is the representation and explanation of a phenomenon as close to reality as possible. By knowledge we refer to *systematic* knowledge collected by established means of natural and social sciences and *experiential* knowledge collected by interactive techniques such as hearings or focus groups. Subject to the provisions of framing, civil society actors and also the wider public may contribute to the broadening and refining of the infrastructure of knowledge and information upon which evaluation and management decisions draw. It is important to note, that it is *not* the task of stakeholders and representatives of the wider public in the epistemic discourse to deal with normative questions pertaining to the acceptability or tolerability of either the threat itself, different strategic options (a set of products/processes/practices which are possible alternatives to the option in question), or management measures for dealing with the threat. These normative issues are part of the evaluation and management phases. They are based on value judgements about what is 'desirable' rather than what is 'true'.

The *reflective discourse* encompasses communication processes dealing with the interpretation of factual issues, the clarification of preferences and values and a normative judgement of tolerability or acceptability. It is mainly suitable for balancing pros and cons, weighing the arguments and reaching a balanced decision on the basis of the epistemological discourse and social values and preferences. The main purpose of participation is here to assure that all values and preferences are included in the weighing procedure, and that the final judgement reflects the societal balance between innovativeness and caution.

The *practical discourse* involves communication processes aimed at the identification, assessment, and selection of different management measures for reducing and managing 'intolerable threats' or 'tolerable but not acceptable' threats. This discourse looks at the variety of possible interventions, addresses the pros and cons for each measure or package of measures and suggests a set of measures that appear to be effective, efficient and fair. The main purpose of participation is

here to assure that relevant knowledge and different preferences are considered in the conclusions on the selection of one or more management measures.

Each of the four discourses produces different types of outcomes that are fed into the next governance stage and enlighten the politically accountable decision makers. It is stressed that, while all participants should have equal rights in the deliberation processes themselves, the responsibility for the final decision lies with the risk managers.

Institutionalisation of participation at the 'interface' stages

It was underlined above that the inter-linkages between the scientific and political aspects of food safety governance are particularly strong when food safety problems need to be framed and evaluated. This 'hybrid' character of framing and evaluation is likely to explain at least in part the need for improved interaction between assessors and managers in the performance of these activities that was expressed by several EU-level and Member State assessors and managers whose views were elicited in the study of the governance systems at the EU-level and in France and Germany where assessment and management responsibilities are allocated to different institutions⁵.

We propose to account for this need for improved interaction by assigning framing and evaluation tasks to a committee which brings together managers and assessors *and* also key stakeholders and works in an *advisory function*. This 'interface committee' would advise on the terms of reference at the stage of framing and reconvene at the stage of evaluation to use the new knowledge from the assessment to draw normative conclusions about the food safety threat under con-

⁵ This empirical research was also conducted within WP5 of the SAFE FOODS project; cf. Dreyer *et al.*, 'Institutional re-arrangements in European food safety governance: a comparative perspective', in: E. Vos and F. Wendler (eds.), *Food Safety Regulation in Europe: A Comparative Institutional Analysis*, Antwerp and Oxford, Intersentia Publishing, 2006, p. 24-30.

sideration which would advise the risk managers in the decision-making. Through membership in this committee key stakeholders in food safety governance (including industry and consumer organisations) would be involved already at an early stage in the governance process. Moreover, the setting up of such a committee would facilitate the co-ordination between political decision-makers, knowledge experts, and social groups at those stages at which accounting for facts *and* values is of primary importance. The role of the stakeholders sitting on the committee would go beyond mere consultation. Instead, they would participate in deliberative exercises as members with equal rights⁶.

The selection of a few 'key stakeholders' to sit on the interface committee would inevitably provoke questions of representativeness, power, and fairness. Therefore, the establishment of a second interface institution which is more inclusive in terms of the voices that it invites to engage in deliberation over framing and evaluation issues might be considered. This institution could take the form of a web-based function that offers platforms for an exchange of views and consultation that relate to the (draft) outcomes of the four governance stages that are documented and opened up for public scrutiny. The proposal for such an 'internet forum' has been spelled out elsewhere⁷. The main idea is to invite and expect participants of the internet forum to not merely state their opinions but to also exchange views, i.e.

⁶ A more differentiated and elaborate proposal (offering and discussing alternative options) for putting framing and evaluation on a formal footing is presented in: E. Vos and F. Wendler, 'Legal and institutional aspects of the General Framework', in: M. Dreyer *et al.*, A General Framework for the Precautionary and Inclusive Governance of Food Safety (cp. footnote 1), p. 67-70. One of the major differences between the proposed options refers to the mandate of the 'interface committee': while one option would imply that the committee deals with all food safety cases, one of the alternative options would mean that the committee deals only with specifically challenging cases.

⁷ *Ibid.*

to discuss each others' standpoints and arguments. Hence, also this participatory instrument extends beyond (however, is intended to include) consultation: it should provide the European Commission and the proposed interface committee not only with individual feedback but with feedback based (at least in part) on discussion, reflection, and persuasion, i.e. with opinions mutually informed by a diversity of views.

A guiding tool for deciding on extended participation

Particular cases might require a more extensive participatory programme (extending beyond the inclusion of stakeholders through the framing/evaluation committee and web-based consultations and deliberations). We would propose to *proceduralise* decision-making over any possible extension of the scope of participation and about the selection of appropriate processes. It would be part of the mandate of the interface committee to give advice on this matter in consideration of the specific case and the given context and the overall socio-political climate.

Aspects that could inform this decision-making process may derive from the internet forum and the stakeholders who sit on the interface committee who can act as 'sensitivity sensors' for highly controversial issues which call for broader participation. In addition, those consultative stakeholder bodies which have been established in the recent years, namely EFSA's Stakeholder Consultative Platform and stakeholder colloquia and the European Commission's Advisory Group on the Food Chain and Animal Health, might be of some assistance in this respect.

While these sources of information already have some potential for facilitating decision-making around the need for broader participation, we would recommend in addition to apply the *preliminary assumption* that under more intractable conditions of *high levels of scientific uncertainty* and/or *socio-political ambiguity* also a higher degree of participation is required. Uncertainty, as defined here, includes the

states of knowledge where either the possible outcomes are clear, but it is difficult to quantify probabilities, or where neither probabilities nor outcomes may be fully or confidently characterised (more specifically the latter state may be referred to as a state of 'ignorance'). Under the circumstance of ambiguity, the problem lies not with probabilities, but in agreeing the appropriate values, priorities, assumptions, or boundaries that apply in defining the possible outcomes. Socio-political ambiguity focuses on the degree to which a given food safety threat may be subject to strongly divergent cultural attitudes, political perspectives or economic interests⁸. The presumption is that under the circumstances of high levels of scientific uncertainty and/or socio-political ambiguity the likelihood of major societal debate or conflict surrounding the threat under review is also higher and hence extended participation advisable.

⁸ For this conceptualisation cp. A. Ely *et al.* 'The Need for Change', in: M. Dreyer *et al.*, *A General Framework for the Precautionary and Inclusive Governance of Food Safety* (cp. footnote 1), p. 11-12; on these concepts see also: A. Stirling, 'Precaution, foresight and sustainability: reflection and reflexivity in the governance of science and technology', in: J.-P. Voß, D. Bauknecht and R. Kemp (eds.), *Reflexive Governance for Sustainable Development*, Edward Elgar, Cheltenham/Northampton, 2006, p. 225-272; A. Stirling, O. Renn and P. van Zwanenberg, 'A framework for the precautionary governance of food safety: integrating science and precaution in the social appraisal of risk', in E. Fisher, J. Jones and R. von Schomberg (eds.), *Implementing the Precautionary Principle. Perspectives and Prospects*, Edward Elgar, Cheltenham/Northampton, 2006, p. 284-315; A. Klinke and O. Renn, 'A new approach to risk evaluation and management: risk-based, precaution-based and discourse-based strategies', *Risk Analysis*, Vol. 22, No. 6, 2002, p. 1071-1094.

8.3.3 Concluding remarks

Participation in food safety governance is currently a greatly dynamic policy field where the use of new participatory mechanisms – largely restricted to new consultation mechanisms - is still in an exploratory and experimental stage. In the preceding sections some suggestions have been presented for how to respond to some of the key issues which are currently discussed in regard to these dynamics (for an overview of our suggestions see the table below).

The distinction between stage-specific purposes of participation is proposed as a conceptual basis on which to organise valuable input (knowledge, interests, value preferences) into the governance process without compromising the functional separation between assessment and management while at the same time accounting for the interface stages at which activities aimed at ‘understanding’ risks and activities aimed at ‘acting’ on risks are strongly interlinked. The representation of stakeholders on the interface committee at the stages of framing and evaluation allows for an early involvement of stakeholders in the governance process and for real engagement (in the sense of symmetrical two-way deliberation) at those two stages where facts and values strongly interact. The internet forum could add to the inclusiveness of the governance process by opening up all governance stages to public scrutiny and by inviting a much greater diversity of social groups to engage with the governance process. The guidance tool for extended

Governance stage	Style of discourse	Purpose As a contribution to:	Institutionalised participation	Additional participatory processes
Framing	Design	Drawing up the terms of reference	Via the <i>Internet Forum</i> throughout the governance cycle	<i>Procedurally</i> , context dependent, and specified at the stages of framing and evaluation
Assessment	Epistemic	Gathering of knowledge and information	At the stages of framing and evaluation: via stakeholder representation on the <i>Interface Committee</i>	<i>Prima facie default</i> : high levels of scientific uncertainty and/or socio-political ambiguity require extended participation
Evaluation	Reflective	Value-based judgements on tolerability or acceptability		
Management	Practical	Selection of appropriate measures		

Fig. 1: A structured approach to participation⁹

participation recommends additional participatory processes for those food safety threats which are associated with high levels of scientific uncertainty and/or socio-political ambiguity. For these more intractable food safety problems a broad participatory programme can lead to governance outcomes that are better informed, better balanced, and socially more robust.

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⁹ This table is drawn from Dreyer *et al.*, *A General Framework for the Precautionary and Inclusive Governance of Food Safety* (cp. footnote 1), p. 97.

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9 Results and Transfer

By Christina Benighaus & Ortwin Renn

Many valuable recommendations for risk communication in general and for the chemical sector were given during the final plenary discussion.

The final panel was made up by Dr. Hans Løkke, the Coordinator of NoMiracle, Dr. Marion Dreyer and David Wright as two of the presenters and Peter van den Hazel as member of the advisory board. Moderator Ortwin Renn focused again on the overall project of the workshop and asked the panel participants what could be the new insights for NoMiracle, and what they take home with them.

“The workshop gave new results of how to integrate the social part of the project, and how to communicate the complexity to the commission and the public”, stated Dr. Hans Løkke, “and now I’m on safer ground. The main object of the project is chemical mixtures, and we concentrate on the special features for communicating chemical risks.”

“What might be the best way to get participants?” was David Wright’s rhetorical question. Participation is a challenging task for risk communication practitioners. He advises looking for specific methods to improve risk communication. The best is to identify the main stakeholders, stimulate their participation, and “wake them up” for the topic. In the STARC project, they put together a generic list of stakeholders. The task is to have a representative group of stakeholders. The advice for the chemical sector is to involve the stakeholders right from the start of the risk communication activity and to ensure those

stakeholders know why it is important for them (what is in it for them) to participate in the decision-making process.

“We learn more and more about the composition of food” continued Dr. Marion Dreyer. She has experienced the tendency at the EU-regulation level not only to look at risks, but to get a view to the benefits as well. While doing so, one realises how difficult it is to come to decisions with really critical trade-offs in judging the different cases. The real challenges might be the mixtures of chemical substances.

It depends on the situation, whether the people in charge could communicate difficult trade-offs or not. *“I don’t see NoMiracle doing risk communication in acute situations”*, argued Peter van den Hazel. NoMiracle could contribute on an information basis, and it could convey messages on multiple stressors.

Tasks and benefits that come out of NoMiracle are:

- have a scientific look to set up a system for comparative substances,
- built a framework, to get insights into dealing with the different risks, and how to set priorities,
- extend knowledge and look at the details.

The next issue discussed was the reference point on which risk experts could base comparisons. Hans Løkke made three suggestions:

- The safety factors could be the starting point. Taking mixtures into consideration, this reference point helps to judge if the mixture is higher or lower.
- Take existing standards for reference.

- Risk mapping is one of the potential answers for reference points. People are familiar with geographical areas. As a consequence mapping could be an approach for communicating risks, providing visual bases for comparison. Maps have colours and a scaling, and people can think about relative differences. Maps might be more useful than abstract information. The panel agreed that mapping is an attractive tool. During a journalist's visit, maps are helpful to demonstrate. Everything could be put on maps, but the risk manager must be careful to avoid misusing or misinterpreting.

"Most of us suffer from an extreme information overload", said David Wright, and assumes that the world is becoming a more difficult place to live in. With new emerging hazards such as global warming and avian flu, it becomes more difficult for people to filter out which information should regard as most important. He emphasized two issues:

1. It is necessary for governments and large industries to make regular surveys of citizens to find out their concerns, and what they regard as the most important risks.
2. People are confronted with an increasing range of risks and hazards that are unclear or not yet finally assessed but are in public discussion. We all must deal with this information overload. It remains important to inform citizens about risks that are serious. The media are an important intermediary between the risk manager and the public; to a great extent, the media set the public agenda by making decisions about information they think the public really needs, and not more or less information.

"The idea of the "traffic light" signal kit in school discussed before is interesting, but the information it delivers when it switches to red when the CO₂ is too high in the classroom is potentially scary", found Dr. Marion Dreyer. Still, in our society we know more and more about risks and

even in schools pupils learn the kind of knowledge needed to interpret the risk information. Pupils will not panic while entering the classroom with a yellow light on.

Hans Løkke brought in that for chemicals, pesticides and pharmaceuticals a lot of data on single compounds are available. The open question is, how large is the contribution of mixtures that could cause incidents. Theoretically, if there is an increased frequency of effects, the next step is to convince authorities about the need for new approaches, but it is a very long way to substituting for existing guidelines for pesticides, which were elaborated more than 10 or 15 years ago and are laid down in different directives of the EU. He summarised two points:

- We should communicate what we are doing
- We should convince authorities of the value residing in new cumulative assessment approaches.

The regulating bodies are aware of the long procedures, and that current methods do not fit the situation. This is the reason why ministries and other authorities are looking for other instruments and methods, like mapping, modelling, health effect screening or environmental impact assessment. They avoid putting issues into regulation, and instead have a kind of advisory system on which they can still make decisions, and to go ahead with something or not.

The Public Health Service Gelderland Midden in Netherlands, the authority where Peter van den Hazel is working, has this health effect screening system in place, and it looks at all kinds of media, at air, water, noise, radiation, i.e. at everything people are confronted with in their neighbourhoods. The system is being used to see what the different options are, what the scenarios are. Taking the example of infrastructure planning, it gives information to build a road straight through the middle, or one that goes around, and it includes all different aspects. The staff finds out if the neighbourhood is getting a bene-

fit taking the road around, or going straight through. One can see if this area already has a burden, together with the other factors, including water, noise and radiation.

The instruments are useful in making decisions, in making options, in changing plans, and are used for big infrastructures or new applications.

The ultimate goal of a risk communication programme, Ortwin Renn noted as the finishing remarks of the workshop, is not to ensure that everyone in the audience readily accepts and believes all of the information given. Instead, it is to enable the receivers to process this information in order to form a well-balanced judgement in accordance with the factual evidence, the arguments of all sides, and their own interests and preferences. To accomplish this goal, a risk communication programme is needed to provide the necessary qualifications to all participants and to empower them to be equal partners in making decisions about risk. In this sense, *ambiguity, complexity and uncertainty are an opportunity for risk management and communication not just a burden*. This shows also that in considering how to communicate risks we can learn a lot about risk assessment.