



**RISK COMMUNICATION STRATEGIES.
Conclusions and summaries of feed-back comments
from participating countries**

Deliverable D18

Authors: Britt-Marie Drottz Sjöberg
Phil Richardson
Jozef Prítrský

Date of issue of this report: 13/12/2009

Start date of project: 01/11/2006
Duration: 36 Months

Lead contractor for this deliverable: University of Stavanger
Revision: Final

Project co-funded by the European Commission under the Euratom Research and Training Programme on Nuclear Energy within the Sixth Framework Programme (2002-2006)

Dissemination Level

PU	Public	X
RE	Restricted to a group specified by the partners of the ARGONA project	
CO	Confidential, only for partners of the ARGONA project	

Foreword

ARGONA is a research project within the European Commission 6th framework programme. The overall objective was to support transparency of decision-making processes in the radioactive waste programmes of the participating countries. Risk communication is a fundamental part of the dynamic process of risk governance. It is essential not to communicate risk *to* stakeholders but *with* stakeholders and Work Package 4 of ARGONA addresses this central topic

The part of the project dealt with in this report has, in the first year, focussed on eliciting the underlying assumptions and frameworks that are developed within different countries with respect to how risk communication strategies related to the management of nuclear wastes are understood and implemented in practice. The second year was devoted to discussions on such frameworks across groups within the various countries, and during the third year the discussion was extended in a cross-national discussion form.

This resulting final report, Deliverable 18, deals with common and unique components of risk communication based on actual experiences from different cultural settings in relation to nuclear wastes issues. Together with other work packages of ARGONA, Work Package 4 contributes to the understanding about the context within which processes of public participation and transparency take place. The intention is that this will support the implementation of such processes in the future development of radioactive waste management programmes.

Kjell Andersson
ARGONA management
Karita Research

List of Contents

Foreword	2
1. Introduction	4
2. Work Structure and Background.....	4
3. Stockholm Workshop ARGONA, September 15-16, 2009	10
4. Method of structuring the materials	11
5. Results	11
5.1 General Summary.....	11
5.2 Comments on Current Developments	12
5.3 Strategic Approaches to NWM Processes.....	13
5.4 Prerequisites for Risk Communication Processes.....	16
5.5 Rules of Thumb Regarding Information and Communication on Risk	18
5.6 How to Improve Risk Communication, Some Suggestions.....	24
6. Summary	24
7. Final Comments	27
8. References	35

1. Introduction

Deliverable 18 is focused on the principal components of risk communication strategies and based on actual experiences from different cultural settings in relation to nuclear waste management (NWM) issues. Essentially it describes how the ideas were presented and developed within the 3rd year of the ARGONA project, in sub-workpackage 4.1. The intention of this work was to delineate good risk communication approaches across national borders, as well as to specify the circumstances that require more specific and unique national or group considerations. Our aim was to provide an in-depth analysis of societal patterns and trends regarding the management of nuclear wastes on the basis of a number of individual participants' understanding and open discussion of the issue between themselves and across the heterogeneous groups represented.

To meet these goals we involved a number of stakeholders from ARGONA participating countries (UK, Sweden, Slovakia, Czech Republic) in a one-day focus group in Stockholm in September 2009. Their task was to provide comments on the strategies for risk communication that have emanated from the various interest groups within the different countries. Another reason for their engagement was to elicit their comments on the central features of existing materials and thus point to any strengths and weaknesses associated with various risk communication techniques and more composite risk communication strategies.

The results obtained reflect the opinions and sentiments related to risks and safety of various groups in civil society within the participating countries. We also believe that the work performed in D18 fits well into the transparency framework provided in the RISCUM model. This model was successfully used in Sweden and has actually also been applied in the Czech Republic within the ARGONA project. It was shown that if applied in practice this model has a high potential for improving transparency related to consensus building in the NWM area.

2. Work Structure and Background

The background presentation at the workshop was structured in the following way:

- Tasks and objectives
- Work design of WP4
- Main results
- Discussion themes

The tasks of Workpackage 4 (WP4) were presented as:

4.1 Risk communication: Strategies, implementation and results (UiS)

- Phase I: interviews with individuals
- Phase II: national focus groups
- Phase III: international focus group

4.2 Communication to different stakeholders of uncertainty and risk associated to different nuclear HLW disposal realistic alternatives (JRC; conducted in 3 phases)

4.3 Integrated approach to risk communication (UiS, DECONTA, JRC, Karita Research)

Similarly the WP4 Objectives were presented:

- 4.1 To compare and summarize different countries' approaches to, and utilization of, risk communication strategies in the managing and storing of nuclear wastes.
- 4.2 To develop a study to communicate to different stakeholders uncertainty and risk associated with different nuclear HLW disposal realistic alternatives.
- 4.3 To compare a carefully-planned programme aimed at improving public awareness about risks associated with nuclear waste.

A short description was given of the previous work phases and their contents. The interview guide used in the first year included seven areas:

1. Historic and national settings
2. Definitions, risk and safety issues
3. Status of current information
4. Risk communication
5. Current national debate
6. Probable future development
7. General background information

The interviews were usually held with one or two interviewees at a time, and the data collections were conducted in the United Kingdom, Slovakia and Sweden. The format of the interview work considered potential cultural differences and for that reason two of the WP4 participants collaborated in the interviewing in each country, i.e. UK/Norway collaboration in the UK, UK/Norway collaboration in Sweden and Norway/Slovakia collaboration in Slovakia. All interviews were held in English.

The work performed in the second year included internal workshops and literature reviews. The external work in the second round of data collections focused mainly on three themes developed on the basis of the previous work. (See Deliverable 5 from the first year's work: "Assumptions and considerations underlying current approaches in nuclear waste management"). The themes were:

- 1: Existing national decision-making structures and risk communication;
- 2: Relationship between the structure and each organisation;
- 3: Suggestions for improvements in risk communication.

The second year work design involved inviting various representatives or interested parties from within each country to group discussions. Examples of involved persons are municipality representatives, those working for national authorities or boards, independent consultants, environmental group representatives and researchers.

The theoretical structure of the second year's work highlighted a) definitions of wastes, history and traditions in the country, b) governance and risk communication strategies, and c) cultural aspects. Deliverable 9: "Similarities and differences in risk communication strategies on nuclear waste management across countries" gives a more thorough account of the theoretical framework. The figure below summarises the core contents in that the "cultural aspects", expressed in national formal regulations and informal behavioural patterns, form a basis for

national governance agencies, which in turn has a major impact on risk informed decision making. The work in WP4 was therefore much focused on delineating what formal systems or practices were developed in the participating countries and the backgrounds or expressed reasons for the existing structures.

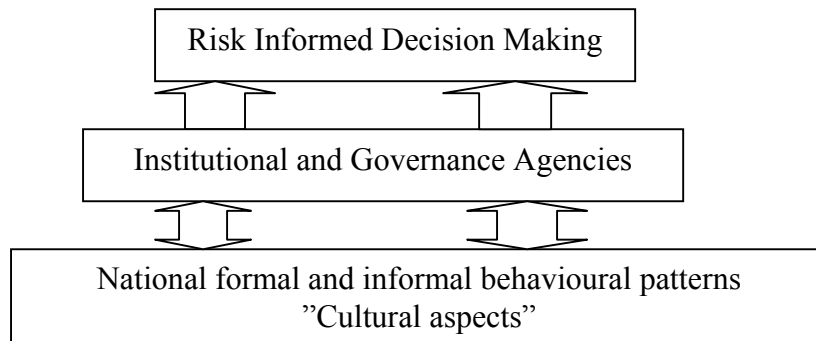


Figure 1. Schematic, theoretical model to guide the selection of target areas for research literature, and for suggesting the relationships between target areas.

With respect to the main results from the earlier work, the introductory overview given at the Stockholm workshop included the similarities and differences between the three participating countries, namely Slovakia, Sweden and the UK. With respect to similarities across countries the following bullet points were listed:

- All European Union countries
- Democratic states
- IAEA collaboration
- Use of international standards
- Environmental Impact Assessments (EIA)
- NWM a national issue and responsibility
- Awareness of the importance of information
- Nuclear wastes attract media attention
- High qualification of experts
- High educational level in the general population

Regarding differences between countries the figure below was presented at the workshop to summarise six major categories of differences between countries that affect risk communication processes, i.e. what type of waste is to be discussed or managed, the economic situation of a state, the availability and status of funding for NMW and repositories, historic events that influence attitudes, trust, etc., the structure and functioning of the social system, e.g. with respect to openness, transparency and traditions of communication processes, and last but not least, developments in the foreseeable future, especially if new nuclear power plants are considered or not. See figure 2. below

Differences & Effects related to ARGONA project

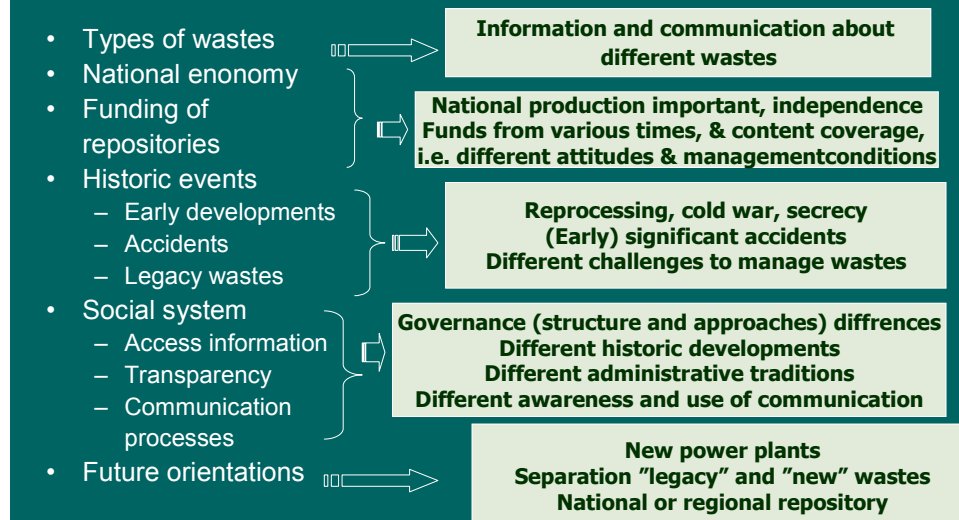


Figure 2. A schematic overview of six main categories where various countries present different contents.

For example, regarding type of waste, Sweden already has repositories for low and medium level wastes (SFR in Forsmark), and an interim storage for nuclear wastes (CLAB in Oskarshamn). The current discussion on a “nuclear waste repository” concerns final disposal of high level wastes such as spent nuclear fuel. In Slovakia there is also an operational repository for short-lived low-level and intermediate level wastes (Mochovce), and plans for a long-lived intermediate-level waste repository. An interim spent fuel storage facility is also planned, but spent nuclear fuel is not currently defined as waste. In the UK the current situation involves a national repository for low-level wastes at Drigg, but which has limited capacity. The current discussions about future repositories involve management of higher-activity wastes, but not spent nuclear fuel which again is not currently defined as waste.

Similarly, the funding situation varies across countries. Sweden has had a “nuclear fund” since 1982, Slovakia developed a fund based on legislation from 1994. The operators in both countries pay a fee in relation to electricity (kWh) production. However, the fund in Slovakia would most probably lack sufficient finances to cover all costs related to construction and operation of a final repository (including indirect costs such as financial compensation to involved municipalities). The UK differentiates between civil “legacy wastes” decommissioned and managed, via taxation, by the Nuclear Decommissioning Authority (NDA) and “wastes from new build” resulting from any new nuclear operator in the future. Such an operator must produce an acceptable Funded Decommissioning Plan (FDP) to the Secretary of State.

The risk communication approaches witnessed in the three countries are framed in very different time perspectives. The UK has the longest history of nuclear waste production, and accidents in the early years, that were not fully revealed at the time have influenced recent planning and communication processes. They have generated negative sentiments and a lack of trust. The UK was also among the early states to start a search for a HLW repository (1975-6), and has also engaged in public inquiries (e.g. 1977, Thorp; 1983 Sizewell). However,

initiatives and plans have repeatedly been abandoned and renewed, and the current situation is based on a 2008 White Paper which initiated a new process firmly grounded on the principles of voluntariness and local participation. It was preceded in 2002 by the establishment of the Committee on Radioactive Waste Management (CoRWM) as part of a new initiative called Managing Radioactive Waste Safely (MRWS). The first phase ended in 2006 and was followed in 2007 by a public consultation on CoRWM's recommendations for waste management. Then, in 2008, DEFRA the responsible ministry, issued an invitation to local authorities to express an interest in voluntary participation.. The current situation in the UK seems to contain a fairly negative general sentiment towards most aspects of nuclear waste management. However, local work and initiatives within voluntary approaches seem at the same time to demonstrate clear differences at local and regional or national levels.

The major highlighting in Sweden of the nuclear waste issue took place in the late 1970's, in a political context on the national level, and in relation to starting up new power plants. Demands were raised for demonstration of a solution to the waste problem before the nuclear power programme could continue. The Swedish implementors met severe difficulties locally in the first years of preparatory siting work in the 1980's and reconsidered their strategy, as well as organisation, before a new long term involvement with volunteer municipalities started in the early and mid 1990's.

Site investigations and consultation processes started 2002, and from 2003 the implementor has been responsible for so-called ' Extended Consultations' according to the Environmental Code (EIA processes), and for intensive information and consultation work in local municipalities. In addition the implementor started a Social Science research programme in 2004, aimed at planning research projects on issues related to decision making and governance, attitudes and opinion, socio-economic effects, and external social change. The current situation includes e.g. the implementor's choice of Östhammar municipality for building of the final repository for spent nuclear fuel and concrete plans for an encapsulation plant in Oskarshamn, etc. The formal comprehensive application, together with all required safety and EIA documentation, will be presented to the Swedish authorities and an Environmental Court in late 2010. The formal reviews are expected to take several years, and may involve feed-back that requires complementary work. The Social Science research programme has so far produced 18 major projects, and each year has held a research seminar involving these contributions and all interested stakeholders and individuals. The overall attitudes in Sweden to building a final repository are predominantly positive, whereas the local attitudes in the municipalities of Östhammar and Oskarshamn have been overwhelmingly positive to such a development.

The situation in the Slovak Republic with respect to governance issues and risk communication processes is that formal structures are in place, and plans of repositories and local site processes are developed or under development. The structural governance system has undergone major changes, however, and the recent history has seen the breaking up of the Soviet Union and a peaceful division of the former Czechoslovakia.

The official governance structure in Slovakia involves the Nuclear Regulatory Authority (nuclear safety), the Licence Holder (nuclear facility operations), the Ministry of Environment (environmental protection), the Ministry of Interior (fire prevention), Ministry of Labour (labour inspection), Ministry of Health (radiation protection), and the Public (local municipalities, NGO's). In addition, the National nuclear fund (collection of payments from nuclear power plant operators, and approval of financing). The National nuclear repositories

authority should be established in 2011 or 2012. In line with the Acquis Communautaire, national legislation adopted in late 1990's and early 2000's enabled participation of the public (i.e. local municipalities representatives, environmental NGO's, etc.) in project permit and decision making procedures (i.e. land use permit, EIA and construction permit processes). The results of the focus group meeting held in Slovakia in 2008 revealed that environmental NGO's have mostly had negative experiences regarding transparency of public authorities and state companies in the nuclear sector and with respect to involvement in EIA processes. Thus, the EIA-work is conducted in accordance with national and EU regulations, but has been criticized by environmental organisations with respect to when in the process information and consultations are performed.

The discussions have furthermore revealed that attitudes, locally as well as nationally, seem closely related to the development of the economic situation. In the midst of the large financial crisis it seems that other concerns have overshadowed those related to nuclear waste issues, and that criticism from environmental groups often is mixed with local interest in some areas regarding repository siting.

Previous work in WP4 has summed up the current situation and shown that there exists a vast amount of information with respect to risk communication processes, but that it is important to continue to focus on enhancing democratic governance. Furthermore, there is a need to inform more precisely with respect to details, various levels of knowledge and involvement, and that a variety of approaches can be used in such work. It has been suggested that interconnecting knowledge and experiences from various risk management fields and practices regarding health-safety-environment threats, e.g. climate change, toxic wastes, etc., may offer fresh approaches and perspectives. This could help to increase "the tool box" of risk communication processes and to test which approaches fit best in such diverse subject areas and cultural contexts. The main conclusion from the project so far has been: *"Think European but pay attention to local detail"*.

The discussions at the Stockholm workshop started on this note and the specific discussion themes were the following:

Discussion themes Day 1

- Theme 1: Utilizing national and international experiences and perspectives on nuclear waste management: Is it reasonable to compare risk communication processes across countries?
- Theme 2: Based on the previous discussion: How could risk communication to the public in Europe be improved?

Discussion themes Day 2

- Theme 1: Are you happy with the way risk assessment is presented in your country?
- Theme 2: (Based on graphical presentations)
 - A) What is a good way of presenting (statistical, graphic) information?
 - B) Are there any central characteristics of pedagogically well presented information materials explaining risk assessment?

This report focuses on the first day's discussions and risk communication processes.

3. Stockholm Workshop ARGONA, September 15-16, 2009

The background to the workshop was that the ARGONA project has reached its final year, and that the WP4-subgroup had planned to get input from different country perspectives to create a basis for summarizing its findings. Work Package 4 has addressed risk communication processes in nuclear waste management (NWM) from two main perspectives:

- WP4:1 examined risk communication in a societal context, focusing especially on the situation in the United Kingdom, Slovakia and Sweden;
- WP4:2 examined the communication of risk messages and the understanding of the communicated information.

The results show similarities as well as differences in NWM across countries, and highlight many challenges in presenting risk information in easily accessible formats or transparent ways. The focus group discussions brought together individuals with various experiences, such as those from work in municipality related tasks, environmental groups, authorities, research and consulting. The aim of the discussions was to get input and comments to the selected themes from the different country perspectives for the WP4 conclusions, and to gain input to the suggested guidelines from the ARGONA project.

The Workshop was held in the Nobel Room at IVA's Conference Centre, Grev Turegatan 16, Stockholm. The discussions were held in English. The workshop gathered participants from

- the United Kingdom (Phil Richardson, Galson Sciences Ltd, and David Moore, Chair of the West Cumbria Sites Stakeholder Group),
- Slovakia (Jozef Pritsky, Deconta, and Peter Mihók, former antinuclear campaigner),
- the Czech Republic (Jan Bušta, stakeholder-citizen living near affected community),
- the Netherlands (Richardo Lavin Bolado, Joint Research Centre),
- Norway (Britt-Marie Drottz Sjöberg, UiS) and
- Sweden (Johan Swan, MKG, Sören Norrby, former SKI, Misse Wester, The Philosophy Unit, KTH).

The participants were encouraged to obtain information about the ARGONA project, and the WP4 Risk Communication work, from the ARGONA website (<http://www.argonaproject.eu/>) prior to the workshop. They were also informed that Karita Research AB has acted as the project coordinator, and that the Swedish Radiation Safety Authority had overall responsibility for the project.

The first day of the workshop was dedicated to the WP4:1 part of the ARGONA project and is the subject of this report. The second day focused on the WP4:2 issues and is presented in Deliverable D17. However, comments and issues mentioned during the second day with relevance to risk communication and the themes of the first days discussions are included in this presentation.

The WP4:1 part of the workshop started with a short introduction of the risk communication work in ARGONA, results to date and information about the task in hand, as described in the introduction. This report summarizes the discussions and comments made at the workshop in relation to the following two themes:

Theme 1. *Utilizing national and international experiences and perspectives on nuclear waste management: Is it reasonable to compare risk communication processes across countries?*

Theme 2. *Based on the previous discussion: How could risk communication to the public in Europe be improved?*

4. Method of structuring the materials

The discussions were based on free commenting on the general themes that guided the sessions. Therefore the approach to summarising the contents has used a “gold-digger’s approach” where the nuggets were separated from less interesting materials. The approach was also supported by the format utilized in the discussions, where comments were asked for from each participant in turn and where the participants continuously added new perspectives from their points of view.

The presentation below involves an overview of the main topical comments, and examples from the discussions, but the structure of the presentation is based on the *extracted main dimensions* emanating from the discussions and therefore does not give a verbatim account of exact statements. In a similar way, the overview below does not necessarily represent the order in which comments were made nor does it always include responses made by other participants, and again, the comments are not presented verbatim. Thus, the structuring of the results from the workshop presents only the “nuggets” extracted from the core contents. In addition, the section below includes attempts at theoretical summarizing of the relationships and causal flows involving these core contents as they appeared in the discussion. It should also be noted that statements in the discussion represent the participants’ personal points of views, and not necessarily validated facts.

5. Results

5.1 General Summary

The first theme of the discussion was: *Utilizing national and international experiences and perspectives on nuclear waste management: Is it reasonable to compare risk communication processes across countries?*

This question was responded to with an initial “No” regarding actual local or national conditions, involving historic and current social and political influencing factors. However, as the discussion continued there were many examples provided of general approaches that were, or ideally would be, common ground for comparisons across countries. Thus, to that end the question was also responded to with a “Yes”. Such generic, theoretical or ideal circumstances are summarized in figures and bulletpoints in the text below. They concern strategic approaches to NWM processes, prerequisites for efficient or continuous communication processes, and rules of thumb in informing and communicating on risk, such as presentation styles, available communication tools, etc.

In response to the second theme “*Based on the previous discussion: How could risk communication to the public in Europe be improved?*”, there was an array of suggestions.

These are structured here under the heading: ‘how to improve risk communications, some suggestions’. The final part of this Deliverable discusses the results.

5.2 Comments on Current Developments

The exchange of views on current developments from national perspectives involved a discussion of the differences in trust in various countries, and possible reasons for the differences. It was noted e.g. that historical situations and decisions have affected trust in authorities. It was considered how much authorities and official bodies are trusted, and to what degree such organisations are seen as *independent* from the implementer. In some countries there even seem to be a view that “independence” involves not being related to the government, apart from independence from the implementer. On the other hand it was also commented that siting municipalities in Sweden had chosen to use state authorities as “their experts” in relation to safety issues, mainly long-term safety and safety assessments. In the UK, however, much of what emanates from the authorities is perceived as “smoke and mirrors”, and people tend to turn to the media for information. It seems hard to know or to understand what agendas the different actors have. A comment related to the Slovakian experience pointed out that trust may actually lead in the wrong direction. For trust to develop there is a need for *enforcing mechanisms* to follow up on mistakes or bad conduct. The discussion highlighted that trust is not good *per se*, but judged in relation to goals and achievements.

A comparison between the current UK and Canadian approaches was made, and the proactive local risk communication approach was highlighted as being more productive than situations where nuclear waste management organisations tour municipalities to feed information into the process. It was added that there is a danger in “forced risk communication” with respect to achieving trust. However, current activities in the UK involve *volunteers* (municipalities) even though these actually turn out to be the same as those previously selected by Nirex (the former implementer). An important key factor in the process is the *independence* of the organisations in charge of the siting process, aiming at a financially efficient, but safe, process. It was suggested that from 2010 progress will be made in West Cumbria with respect to development of a “partnership” approach (as laid down in the MRWS process).

An example of how trust is enhanced in an unobtrusive way was provided from the UK, and the Seascale area in particular, where people working at Sellafield subsequently chose to retire in the coastal village. Their choice of staying close to the plant and industrial area was seen to provide an unspoken example of their attitude. However, it was also said that the NWM issue is politically very unpleasant. Examples to support this notion can be found in USA, Germany, and in many other countries. Much of this has to do with the culture in different countries, but the role of differences between generations was also discussed. It was pointed out that the extent to which various “generational cultures” vary, across and within countries, with respect to interests, care or environmental attitude, and questions of central importance to them as an agegroup, may have an impact on trust levels.

In addition, to be *representative*, e.g. the composition of bodies influencing the decision process in terms of type of interests or “stakeholders”, should be considered. For example, an attempt to involve environmental NGO’s in the European Nuclear Forum has failed, because inclusion of many of the latter group meant the Forum consisted of 90% industry-related

individuals, resulting in a very strong focus on industry issues, which the NGO's felt unable to support.

The figure below summarizes the key factors mentioned in the discussion, and suggests that independence of actors, especially central decision makers, the functioning of enforcing control mechanisms, voluntarism, and the involvement of a variety of "stakeholders" and behaviors can influence trust and distrust. It must be noted, however, that the "trust" and "distrust" outcomes depicted in the figure are not good or bad *per se*, but judged within a complex situation and in relation to e.g. goals and achievements.

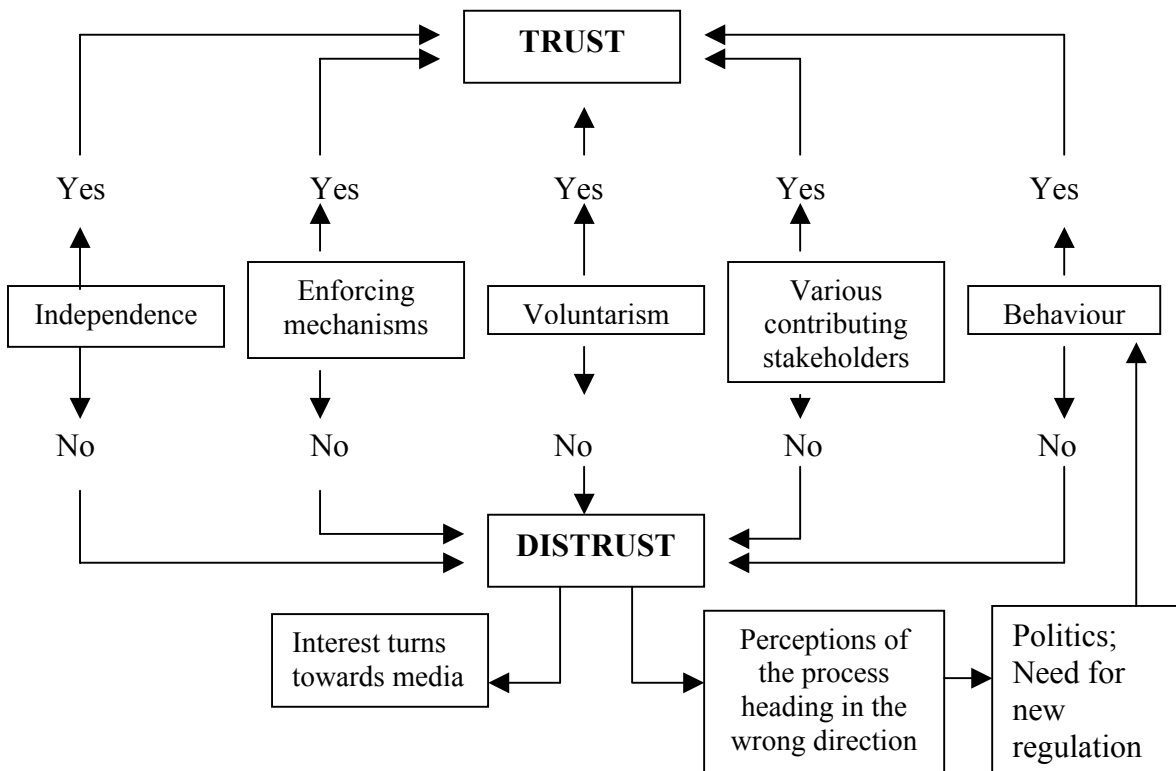


Figure 3. Theoretical summary of key factors in the discussion.

5.3 Strategic Approaches to NWM Processes

It is important to recognise what the *goal* of the risk communication work is. Is it e.g. to inform, to raise awareness, or to gain acceptance? One participant believed the goal is to gain acceptance for NWM, and added that there have been many problems in different countries in this connection. Instead the *long-term safety issue* should be the main focus, i.e. the 100,000 to a million years' perspective for the repository system. The view was that the current discussion is not really focused on long-term safety. This person stressed that a core issue relates to *governance*, i.e. how different aspects come together and how one takes care of all perspectives. It was added that long-term safety builds on trust.

One commentator asserted that we do not have to prove safety over a million years – it is the *now* that matters with respect to safety; thus presenting a different view on the importance of

the long-term safety focus, stating that radioactive wastes decay over time, and that the central focus instead ought to be the repository safety issue as a whole. If safety can be assured, then it should be possible to inform people about that. However, in this respect there are many uncertainties involved, and much work remains to be done regarding risk estimations and risk communication in this area.

Furthermore, safety assessment results are very difficult to understand for ordinary people, and anyway, people want *zero risk*, in spite of there always being a risk, e.g. a dose. How to solve this equation is the task in approaching risk communication. An example of this type of challenge was provided from the Swedish Stipulation Act in the late 1970's, which asked for absolute safety. The example aimed at illustrating the existence of a "political safety case", e.g. "a conceptual case" in contrast to the more quantitative assessment approach. The "absolute safety" notion was seen by the group as absolute nonsense from a technical and scientific point of view. The discussion returned to the long term safety issue and underlined the *inherent uncertainty* involved in social and political changes, and suggested that relatively speaking there are fewer problems or uncertainties with technical systems.

Someone asked why we are going into the siting phase so quickly (in Sweden), and underlined that one should separate more clearly the aspects of "recommendations" and "implementation of recommendations" in the NWM process. It was also suggested that "*the safety case*" has been a problem from the start because it has been approached as a purely, or mainly, technical issue. But one has to ask if it is purely technical. Is it not basically a philosophical problem? There were different opinions on this idea among the participants in the group. Someone argued that "the safety case" is defined solely by regulation. Another comment was that the Nuclear Energy Agency (NEA) of the OECD has a specific group dedicated to the development of the concept of "safety case" and of all the ingredients of this concept. It is the Integrated Group for the Safety Case (IGSC). In 2004 they published the report "Post-closure safety case for geological repositories. Nature and purpose", which illustrates very well what the safety case is.

One person pointed out that the safety case can either be focused on technical requirements for a nuclear facility, a case evaluated in a comprehensive safety assessment, or it may be a wider case presented by an implementor e.g. in an application to construct a repository, including more than technical aspects, but in principle restricted to aspects related to safety. Someone else claimed that it involves e.g. acceptance issues. It was thus asserted by some participants that it is necessary to define clearly in information and communication situations what "the safety case" is, or how the concept is to be utilized. The importance of looking at exactly which the requirements are for a licence application was noted as well.

It was also suggested to explore, in a concrete way, what would happen if there is no decision (about a repository); this could serve as an example of basic strategies, and offer a fresh approach for many. Provide comparisons, e.g. of what can be implemented, was the contribution from one participant. Involve "small step-wise decision making" procedure, i.e. make use of shorter time lines, was suggested by another. Others suggested making use of the "willingness to pay principle". The importance of being aware of the *agenda setting* from the start was mentioned.

Some recommendations were put forward in this context: Concentrate on safety; if safety cannot be guaranteed then just look for another site. Clearly provide the *criteria* for regarding, or disregarding, a site or locality as interesting. Define also clearly what are unsuitable sites or

bad areas. It was also underlined the the NWM process must involve considerations of all aspects, e.g. from safety analysis to benefit packages. Look into the dynamics of the “stigma bargain chip”, for example. Consider *options*.

In addition, there needs to be some kind of basic *independence* defining the whole process of NWM. That also involves information distribution and quality of information sources. It was asserted that in Sweden most information comes from SKB, the Swedish implementer. Later comments to this statement pointed out that one must not disregard existing features compensating for this situation, e.g. comprehensive and broad reviews of R & D programmes, requirements on EIS, financial support to environmental groups, etc.

A short discussion took place on the appropriate definition of “independence”. One suggested definition was “not to have been involved in the reviewed project”, whereas “the involvement of elected people in the process” highlighted another aspect. The term “*expertise*” was discussed in a similar manner and a definition attempted. *Competency* and *honesty* were mentioned as central components. A suggested definition of an expert was ‘someone judged by an expert peer group to have the required competency’.

The discussion went on to comments on how to select “*stakeholders*” and who should be in charge of such a selection. It was stressed that it is an agenda setting issue of how persons participating in information meetings or panels etc. are selected and presented. How is the selection of organisations, “*stakeholders*” and persons handled within the national contexts? Is it a matter of a “tick in the box exercise” relative to official requirements just to be able to demonstrate an acceptable procedure, or is it a process involving something else or something more? It is important to consider who or what different “*stakeholders*” represent. According to some participants of the Stockholm workshop, not enough consideration has been devoted to this issue in their countries, and thus representativeness needs to be better clarified in relevant legislation or procedural rules. An aspect of the issue is how to handle a situation in which the often referred to “general public” does not show an interest in e.g. information or public meetings.

Voluntariness and choice were pointed out as important in strategic planning, as was the current development of ‘partnerships of interest’, e.g. in the UK. The strength of the “partnership” concept is that it gives a community the right to “walk away” from further engagements if they so wish. It is still an issue in the UK, however, to define what “the relevant community” is and how to specify the borders to areas not included. However, the veto-right is important to local communities if they are to consider becoming involved in a siting process at all.

In this context it was noted that in the UK a land owner could suggest that his/her land be used to site a repository. Historically, British Nuclear Fuels bought farms in Cumbria when they became available, and today the Nuclear Decommissioning Authority consequently has a lot of land at its disposal, some of which may be used for “new build” of nuclear power plants. It was also noted that much of the focus so far has been directed at siting or repository issues, whereas little attention has been paid to transportation issues. The assumption was that transportation issues may become a larger issue than “the safety case”, e.g. in West Cumbria.

Summing up the input from the discussion, recommendations included taking good account of previous experiences; to compile the results in a project or a report on risk communication, and governance; to reach out to interested local communities and those with questions, with

information and possibilities for dialogue. It was stressed that trust is built, it is not simply existent or non-existent. Trust is an end result of a longer process of interaction, and trust is constantly reevaluated.

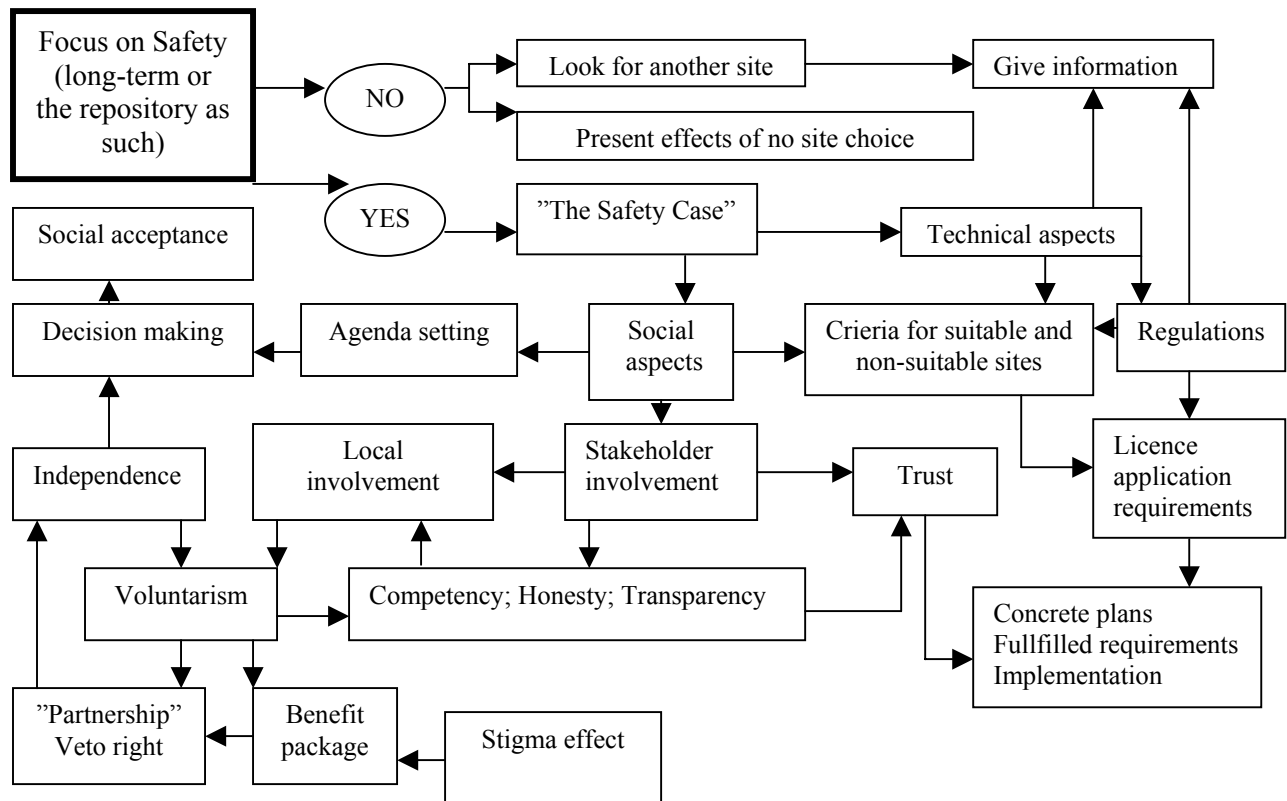


Figure 4. An overview of concepts used in the discussion, and suggested influences.

5.4 Prerequisites for Risk Communication Processes

It is important to ask the question “Risk communication about what?” What is the *goal* of the communication? Is it about safety issues, specific analyses, general information, attempts to contribute to improved knowledge, etc.? Make use of, and improve, available materials through good examples from work in other countries.

Voluntarism is a necessary basis for risk communication and participation processes. The current west Cumbria process, in the UK, is one example. This process is led by the local communities. For the time being there is no absolute definition of “host community” or its borders in the 2008 White Paper on radioactive waste management, but the process goes on and currently involves three different political levels. The concept of partnership has played an important role in the development.

Furthermore, *consensus* is an ethical starting point in developing a risk communication process, although this is very hard to achieve. It could be possible to use examples from countries more advanced in the process and try them out in other countries. *Trust* is

imperative, and therefore it is important that there is *transparency* about whose interest, ideas or initiatives it is that are allowed to evolve.

When discussing *trust* it is important to differentiate between different kinds of trust, e.g. trust in information regarding what science can contribute to or solve (epistemic trust), and “social and political” trust in the institutions involved. Issues related to different kinds of trust elicit different kinds of responses. Regarding the question if it is reasonable to compare risk communication processes across countries one may respond “yes” in relation to communication involving suggested technical solutions and communication tools, but “no” with respect to comparisons across countries’ social and political orders.

One should also distinguish between local knowledge and knowledge in the general population. Local groups and people tend to be better informed. However, trying to get a message across successfully to a group with no experience of risk analysis that, e.g. it would take 3-4000 years before any impact would be likely to occur in a repository, would depend heavily on the social trust and credibility factors attached to the presenter and that person’s ability to explain as well as to respond to questions. Not to understand sometimes means to lose control, which generally is a feeling creating negative sentiments. Thus, bad explanations or unsatisfactory responses can result in negative feelings toward the subject matter even if what was said is academically correct.

It was noted that one type of communication or content will not cover all perspectives or information needs among interested individuals or municipalities. It is necessary that people receive correct, as well as understandable information, and that they trust the information source. For this reason the perceived *independence* of the information source is necessary. For example, regarding “the safety case” it is sometimes taken for granted that the regulator (authority) is the public’s “eyes and ears” with regard to obtaining the best outcome. However, this is not always the case, and it is important to show people how, when and where they can participate, contribute or make a difference in the process.

One participant was concerned about the apparent paradox involved in the suggestion that everyone should be informed, whereas many people obviously are not interested or do not want to be informed. Therefore, the need to *create interest* for information about NWM was underlined. It was noted that not much work has been done by universities in the risk communication area in this respect.

The figure below aims to illustrate the central concepts of the discussion and their main dual directions or possibilities, i.e. toward the central “yes-area” and a continued communication process if a prerequisite is fulfilled, or the external “no-area” of various kinds of unsolved problems when a prerequisite is low or lacking. It is suggested that the prerequisites are all available as starting points for an improved communication process. Note, however, that the positive development is a continuous communication process, not necessarily a successful one.

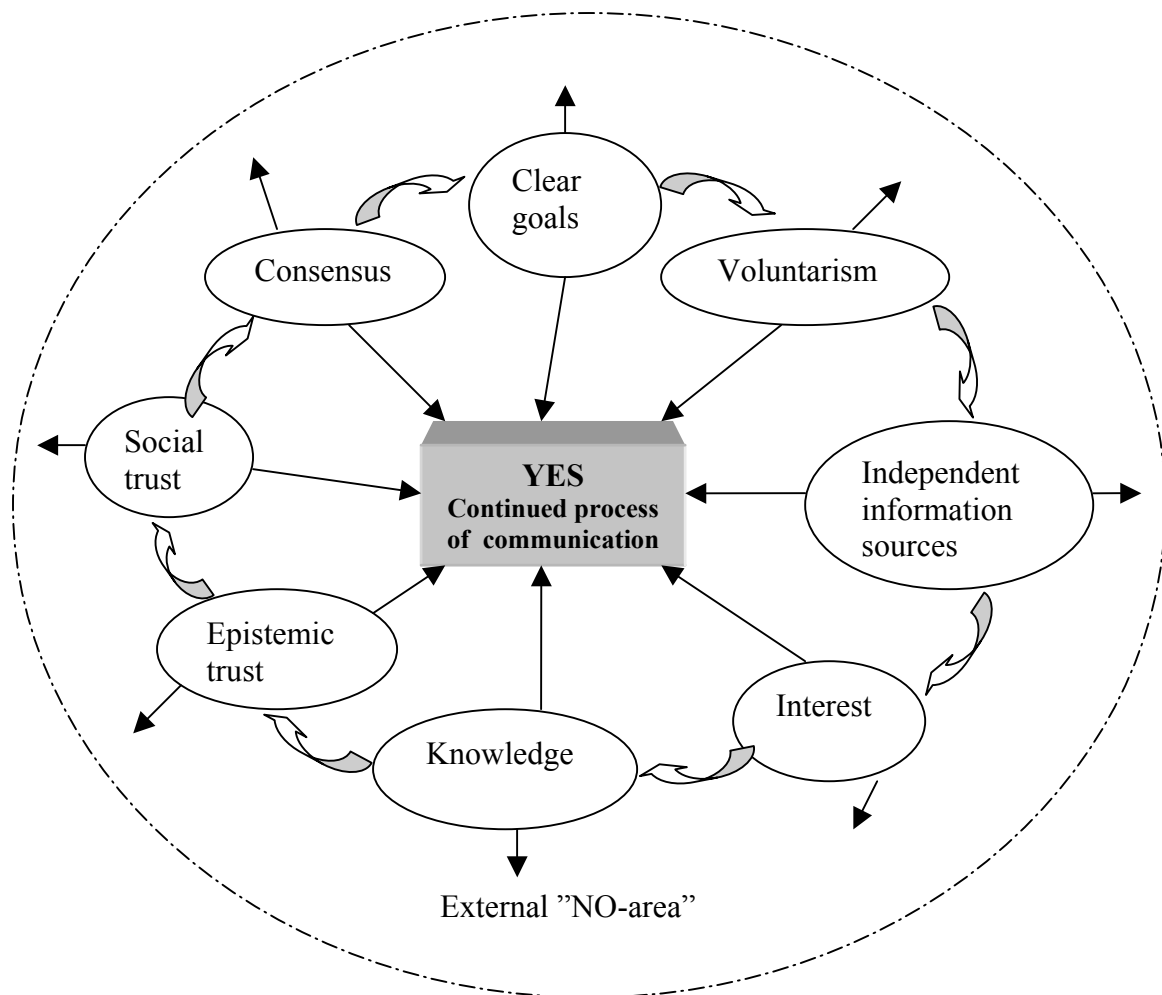


Figure 5. A loop of prerequisites, and perpetual influences, in continuous communication processes.

5.5 Rules of Thumb Regarding Information and Communication on Risk

The following comments were extracted from the discussion regarding more general “rules of thumb”:

- Make all kinds of information available, on different levels, regarding the types of prior knowledge required.
- Explain where information can be found.
- Accept help from “key people” who can carry information to other groups.
- Interact with schools to provide basic education about e.g. radiation and risk issues.
- The Internet is important; make available various kinds of reports, protocols, and links to more information, etc.

- Develop interactive websites; see e.g. the Regional Council in Uppsala's current homepage.
- Investigate which are the most frequently asked questions and provide easily accessible responses and documentation about the issues. For new questions, or questions related to issues that are currently the focus of attention in e.g. science, media, or a local community, the information requirements are different. Such issues may involve explanations of various kinds of uncertainties, explaining known basic facts, or strategies to further explore the issues.
- Differentiate between scepticism expressed in “epistemic uncertainty”, i.e. not knowing what types of problems science actually can give a correct answer to, and distrust, i.e. distrust or little “social trust” due to organisational affiliation, personal reputation, unfavourable media coverage, etc.
- Invite people to meetings, group discussions and face-to-face encounters.
- Listen to the participants' questions and interests. Questions need honest and updated responses, also with respect to pending uncertainties, available choices or future options.
- Make clear distinctions between “what has been done” and “what should be done”. For example, when reporting on “results”, make sure to communicate whether the results represent purely theoretical or simulated outcomes, or if the findings come from experimental or site specific tests conducted at a chosen site, etc. It is not until in the licensing application phase that details are really tested. Observe in such a context the various different understanding or expectations related to “the safety case”, e.g. as a technical challenge, as a conceptual proposal of “safety”, or as a site specific issue that requires local acceptance.

Rules of thumb more closely connected to public meetings are presented below:

- Develop different kinds of meetings, e.g. with larger audiences, seminars, small group discussions, group work possibilities, etc.
- Provide different types of informative materials adapted to the particular situation, and offer a possibility of follow-up and feed-back, for e.g. different interest groups or generations.
- Complement information with meetings where experts can respond directly, and meet people face-to-face. Also a single meeting can be divided up into various parts, such as a choice of presentations on various subject areas, or small group discussions, in different rooms.
- Use the RISCUM “stretching” technique in sessions with a panel of people holding different competencies from various fields asking specific questions to experts.
- “Hearings” or “stretching sessions” can be used as meeting formats to get deeper into selected themes, e.g. copper corrosion, water flow, decision-making processes, etc.
- Make use of selected, experienced mediators or facilitators. There are “personality factors” involved here as well as knowledge of an area and other competencies, i.e. technical abilities or competencies, personality abilities and previous experience.

- Recognize the audience you are talking to or with, and change the format of communication if necessary.
- People will often pick up what they perceive as wrong or missing information. *Never* dismiss anyone, or anyone's question, as stupid, unimportant or irrelevant.
- Never underestimate the potential concern a person may hold about an issue, and do not guess about the reasons for such possible concern. Instead respond to your best ability and, if the situation is appropriate, inquire about or discuss ideas and associations attached to the issue.
- An interesting situation that may occur in relation with presentations to audiences is when outspoken proponents and opponents use a meeting arena to present *their* messages instead of debating the issue brought forward by a presenter. Such situations are characterized by the highlighting of alleged mistakes and displays of distrust. The scenario of attempting to gain public support from an audience should not be mistaken for an educational arena, and it seldom engages others than the spokespersons for the respective causes. People in such an audience that were interested before the dispute, or had brought specific questions, usually become reluctant to get involved under such circumstances. Their impressions of the presentation or meeting often become tainted by the experience and they can exhibit discomfort or dissatisfaction.

Specific terminology was highlighted as a communication obstacle. The group discussions gave several examples of terms and concepts that must be used with caution:

- It is usually difficult to explain to a lay audience what “deterministic” and “probabilistic” approaches mean. It was suggested in the discussion that if it is necessary to introduce these concepts then it is more pedagogical to start from a deterministic angle. A suggestion was “pick deterministic reference scenarios instead of probabilistic discussions”. However, different theoretical frameworks and specific technical uses may give such terminology slightly different meanings. It is therefore suggested to remove such terms altogether in presentations to citizens and to aim for a much more concrete approach and, if possible, the use of everyday terminology.
- An especially problematic concept is “uncertainty”. For many people it means simply “don't know”. It may not make sense to a person who holds such an understanding to grasp that degrees of uncertainty surround the presented estimates of risk. And confusion would certainly be a fact if the scientist is unaware of the listener's different understanding of the concept. It could be of some help if scientific concepts generally, but specifically those carrying ambiguity viz-a-viz daily uses of language, are defined and clarified early in a presentation and discussion.
- It may also be problematic to use the concept “conservative” since it has many meanings in ordinary language, and not necessarily translates to “fail on the safe side” as may be intended in risk assessment contexts.
- A similar presentation challenge is attached to the work “risk”. The impossible task of achieving zero risk can easily be misunderstood if there is a tendency to think in “black-and-white” categories, i.e. in terms of “is there a risk or not?” To enhance clarity and facilitate

communication it was suggested that one uses a spectrum of examples, and styles, as well as initially spend some time on explaining basic concepts and constructs.

The group discussions also dwelt on presentation methods and styles. The suggestions below were extracted and are presented here in no specific order or classification:

- There should not be too much detail in presentations for non-experts. Details require prior knowledge, and it is important to outline a general overall orientation of a subject area or problem before going into details. For example, the water-flow situation in a repository, how to explain that? One possibility would involve clearly demonstrating what assumptions are involved, and what has been taken into account in the analyses performed before results or assessments are presented. The explanations could be enhanced by pedagogically developed graphs, tables, and plots.
- Slides in presentations always generate questions; start explanations from the questions generated by listeners.
- Demonstrate e.g. doses over time on understandable time scales. Include information about e.g. regulations and requirements, i.e. the framework within which analyses were conducted.
- Explain clearly what scenarios and parameters are involved to reach an estimate or, in the a social context, a decision.
- Make sure that all “optimists” as well as all “paranoics” have their hopes and fears addressed.
- Remember that people are interested in “worst case scenarios”, no matter how unlikely such scenarios are. Be prepared to discuss the worst of the “worst case scenarios”.
- Explain e.g. what “the safety case” refers to before getting into details of risk assessment.
- Make explicit comparisons between good and bad sites for a repository.
- Put risk communication in the context of life, i.e. life is a risky business.
- Present concrete examples, e.g. make examples of a repository in Stockholm city, at a beach, and other available places.
- Explain pros and cons of the matter at hand.
- Level and detail of contents must be adapted to the people who should use or understand the matter. Support or validate information at all levels, e.g. for persons without as well as with prior knowledge.
- Do not only consider the contents of the communication, but look also at the level of difficulty regarding e.g. abstraction, choice of concepts, use of language.
- Present or produce different types of information, for example, classify different groups of people regarding their prior knowledge and concerns and start from there. The *level* must always be correctly adapted.

- If the contents or messages from a prepared presentation seemingly do not meet the information need or interest of a group, then be prepared to change not only the presentation, but also the presentation format.
- Respond to the questions *they* have. It is important to provide plenty of time, and many examples, in a presentation.
- Clarify early in a presentation what type of message you intend to give; listen to what questions people ask, inquire what they want information about.
- It is important not to make mistakes in the presentation of facts and information. Mistakes certainly involve giving incorrect information, but also to be too confident when information contains uncertainty or is scientifically disputed. An example from the UK illustrated a situation where confidence was lost due to a suboptimal presentation of water-flow estimates, and where other correct information was tainted by the mistake. Why should I believe you now? The commentator underlined that you are not able to go back on something that you as an expert has stated as the truth, so there is reason to be well prepared. If you go back on information previously presented as “true” or expertise knowledge, then trust is gone. It takes a long time to build up reputation and trust, but a single mistake may destroy it very fast.
- Make presentations similar and recognizable across time so that non-experts can relate to prior information. It is important with repetitions, and continuous contacts, to enhance understanding.
- Train and develop good pedagogical skills. One participant emphasized “Most important is *how* I explain something”.
- There are good reasons to differentiate between “generic reviews” that are basically theoretical and have different scope and contents than e.g. reviews of site specific issues. In the former situation many can have an opinion, comment or ask questions, whereas in a specified expert area comments and sharp questions require prior knowledge and expertise in the field and of the specific case. In the latter type of case it is necessary to involve “peer reviews” for profound scrutinizing of the subject matter.
- It should be remembered that people in municipalities do acknowledge that they do not understand safety assessments or modelling. Therefore it is not a problem, quite to the contrary, to present information that is basic, or very simple to the expert, in a more easily accessible way. It was strongly suggested that one should give community people the possibility to comment on information or presentations to adapt them to the adequate level.
- “Safety” is one key issue. The long-term perspective requires understanding of performance assessments, etc how to do calculations and their bases. With respect to the general public we need to be careful about details, and e.g. distinguish between safety related to technical calculations or e.g. the properties of different types of wastes, and the functioning of various organisational systems and how to trust them. There are many different political or systematic overall approaches developed, and they cannot easily be compared. However, good aspects involve careful programme planning, continuous, repetitive and independent reviews of that process. What kind of comparisons can be made? Well, there is e.g. the type of repository, e.g. bedrock, salt, clay. There are also the differences between low, medium and high level

wastes, etc. But information is often too general, i.e. just presented as a “nuclear waste repository” that does not pay attention to detail or connect to actual, available knowledge.

- Make comparisons with other areas, e.g. risk related to natural radioactivity, nanotechnology, stem cell research, etc. Provide perspectives that also compares perceptions of time spaces, e.g. climate change, the developmet of species, etc.
- Simplifications carry their own problems. Some of those are related to expectations or attitudes and others to prior knowledge level. A listener may very well be especially concerned about, and knowledgeable in relation to a certain aspect and would therefore not be content with too general information or answers. On the other hand could such a person certainly be totally uninformed about another speciality area, and react with indignation to detailed information without a review of the overall context?. Probably continuous experience with different audiences is required to be able to foresee and understand the expectations of an audience or a specific group or person. Communication training comes with good feedback from meetings with various audiences.
- Should we work more through the media? Media does not have or give the “full picture”, and they often have their own agenda, so the approach is difficult. Furthermore, you cannot “blame” the media, it is futile. Media actors need to be better informed when they write an article, but when they write an article they have to consider what sells papers, although they usually understand the agenda. But in some countries, e.g. Sweden, the media is also perceived as biased. Of course, there is freedom of speech, and it is often hard to prove that a media article is totally wrong due to all the surrounding uncertainties.
- One has to consider all the different kinds of media output, e.g. there are serious and less serious newspapers, various types of TV-programmes, news and commentaries, national and international journals, etc. Also considering the pressure put on journalists one cannot always expect good, reliable information. There is also a tendency of duplicating from already available sources which may amplify a message. However, all countries have journalists with real expertise in commenting on scientific results, without having a stake in the matter. These could be approached or engaged in information exchanges.
- It is important to use local media, because they are more knowledgeable about the local developments and the local population and are more interested in local, everyday events. Further away from a site the interest is lower, and there is often no great appetite for information at the national level. Siting is an especially local issue although it is also a national one as well. National media, on their part, tend to have a focus on accidents or events of a more sensational quality. Today one must consider also the internet, and internet media transfers.
- Remember that nuclear communities have a higher awareness level to start from (in terms of information and communication). If you are sure about “the safety case” then there should not be a big problem informing about it. However, make sure the NGO’s are involved, and realise that every party (NGO’s, industry, researchers, authorities, etc) have their own agenda or roles and commitments. A common theme, however, is that we have to take care of the nuclear waste.

5.6 How to Improve Risk Communication, Some Suggestions

The group discussion pointed out that one of the most important aspects of improving risk communication is that the information should be based on independent sources and reviews. A possibility would be to use the IAEA in such a capacity, or otherwise to consistently make use of independent organisations or groups. In the case of NWM one could envisage use of a “European group” to examine all “safety cases” across the member states, in order to investigate similarities and differences. Another suggestion was to set up a credible review board in Europe, e.g. a European Academy of Sciences, to fulfil the task of independent reviews. It was also underlined that all international regulations “should” be implemented in EU countries, e.g. the Euratom treaty, and other legislation, so that all nations developed similar practices.

In a similar vein the discussion put forward the suggestion that competitions could be held involving member states of the Europe Union with respect to the ‘*Best Presentation of Safety in Nuclear Waste Management*’. Such competitions should have a broad panel of persons from a variety of competencies acting as judges. Their tasks should involve e.g. to evaluate contents, format, comprehensibility, and dissemination efficiency, etc., of the presentations. The overarching role of such competitions would be to highlight the importance the EU attaches to adequate information transmission and risk communication ability related to nuclear waste management issues.

Whatever direction NWM and dissemination work take, the group discussion summarised that all suggestions or decisions in such processes need to be reviewed and discussed. Such reviews could be of different kinds, e.g. peer reviews, independent groups’ reviews, etc. and they could refer to single events or composite, strategic approaches. The core concern was to aim for and include “independent” second opinions.

6. Summary

The discussion in the international focus group started from considerable experience and knowledge of the participating countries’ situations. Thus, there was not much overall review of the current national state-of-the-art, but rather examples of current trends, and comments or offerings of comparisons to other participants statements.

There was agreement that historic perspectives must be taken into account when trying to understand a specific NWM process. Historic events and decisions steer the developments and e.g. choices of risk communication processes along certain paths, which may be difficult to understand without the knowledge of developments over decades. In this respect the group found the task of comparing current national risk communication processes across states to be difficult. However, the discussions did point out generic themes and prerequisites for good or improved risk communication processes. These themes and examples were outlined in the text above. Central themes involved independence in decision making and in various review processes and, as a defining characteristic of the whole siting process, the representativeness of stakeholders, the need for functioning enforcing legal mechanisms, the importance of voluntariness in municipality participation in discussions on siting a repository, and the central role of proactive local information work. It was noted that the representativeness issue is not well defined, and that classifications and e.g. geographic borders, related to those citizens and organisations who should be involved in deliberation and decision making processes, are the main challenges in the immediate future in most countries.

Regarding strategic processes the importance of goal setting was underlined, as were the needs for a well planned and adequate governance process, considerations of short and long term planning horizons, and the actual pace of current development. Clearly defined work agendas were requested, and an awareness of the importance and role of agenda setting early on in a planning, or e.g. risk communication, process. It was suggested that experiences from other countries or projects were considered in the work and planning. The international focus group dwelt for some time on issues describing “the safety case”, its contents and social role. Although “the safety case” is a well defined area of expertise, the social importance of how and why the work is performed and the evaluation and impact of the results are not technical issues. In a strategic context, the discussions brought to light the need for a transparent description of the role of scientific and technological long term planning within current society.

The figure below illustrates that the safety case is influenced by short term social and political issues, but also by social phenomena such as “trust”. The concept of “trust” here represents an end result of a series of circumstances including “independence” in decision making, “representativity” in the process, and “accountability” with respect to openness and transparency and responsibility in decision making. In turn, the generated degree of “trust” influences the short term politics, via consensus building and active communication processes. The figure also shows that there are relationships between the core concepts. For example, “independence” between actors or with respect to actors flows into the review process, which in itself contributes to perceptions of accountability and trust. Furthermore, “representativity” has direct influences on “trust”, “consensus” and participation.

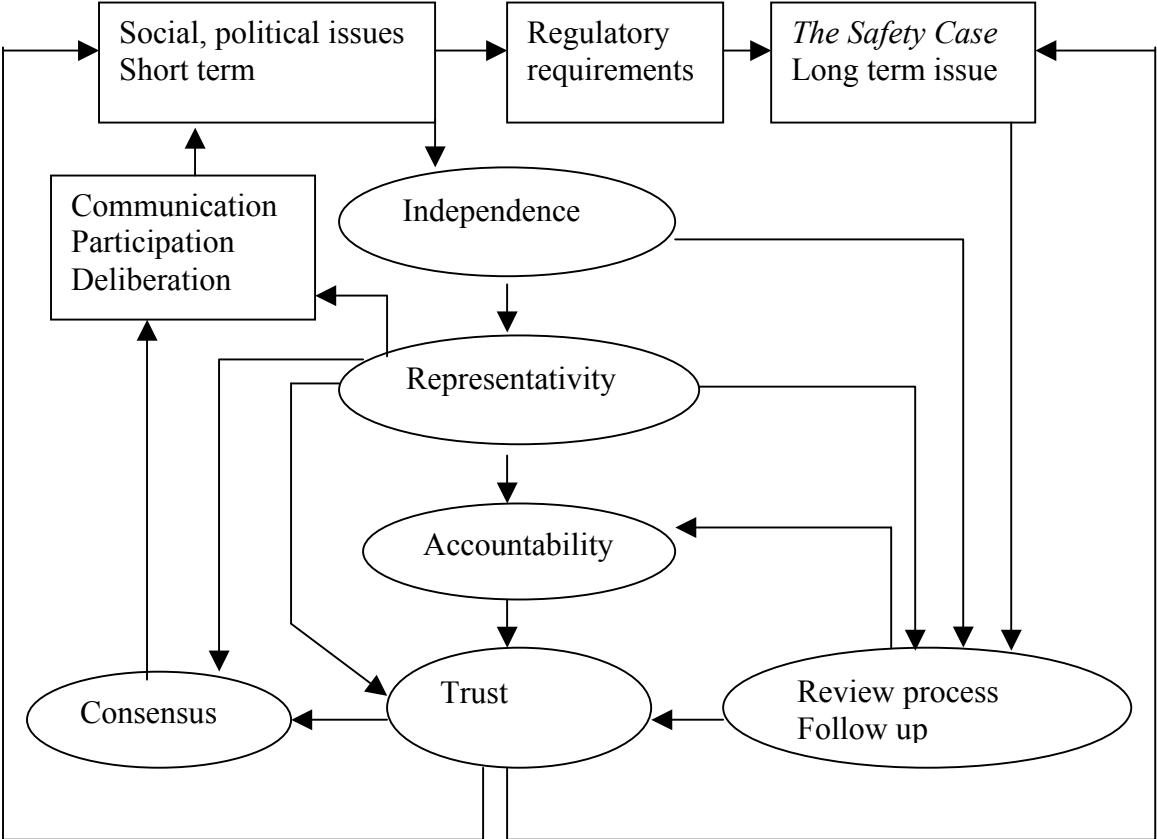


Figure 6. Generic summary figure of the discussions.

The table below structures some of the most important input from the international focus group discussion in a different way. Five steps of a possible NWM process are outlined, together with some notions of content and requirements.

Table 1. Overview of the important major steps, and examples of contents and requirements, in a possible NWM process focused towards implementation of repository plans.

Steps	Content	Requirements
Strategic consideration	Provide reasons for planning a repository	Independence (reviewers, decision makers)
	Clear definition of “safety case” and evaluation of feasibility	Transparency; independence; trust
	Choice of governance perspective of process	Functioning enforcing control mechanisms
	Clear criteria for regarding/disregarding a site	Consideration of “all” aspects
	Creation of inclusive social communication process	Social acceptance Openness
Agenda setting preparations	Clearly define the agendas for the technical and the social processes	Overview of uncertainties and clarification of “representitiveness”
	Consider pace of development	Distinguish short and long term issues
	Proactive information	Information availability; understandable to target groups
	Prepare for involvement of stakeholders	Procedure perceived as fair
Contacts and discussions	Create interest	Preparatory work
	Invitation to participate	Voluntary processes
	Present uncertainties	Availability of pedagogical experts
	Discussions on e.g. “the right community”, “partnership”	Interested local communities
	Investigate possibilities of local steering mechanisms	Availability of local control mechanisms, e.g. veto-right
Recommendations on risk communication	Provide and keep available information in various formats	Clear goals of each intervention
	Use correct and understandable information materials	Invite to feed-back on information materials
	Involve key group members	Extensive (local) network
	Collect and improve on available materials and experiences	Compilation of research results; new research
	Development of presentation techniques and skills; training in dialogue settings	Understanding of novel perspectives in the personal expertise area
	Work with “translations” of scientific terminology and ambiguous concepts	Cross-disciplinary collaboration; involvement of lay people
Implementation	Developments of concrete plans and work	Continous updates of key factors related to technological and social developments

7. Final Comments

Certain specific risk communication issues tend not to surface in discussions on cultural comparisons and governance. For that reason a few additional notes will be made on risk communication per se (see also Drottz-Sjöberg, 2003).

Several models of information and communication processes can be found in the literature. Figure 7 below is based on McQuail (2000) and presents a larger perspective of communication processes on various levels, from the individual information processing level at the base, to the mass communication level at the top. Each of the communication levels presents specific types of possibilities and problems.

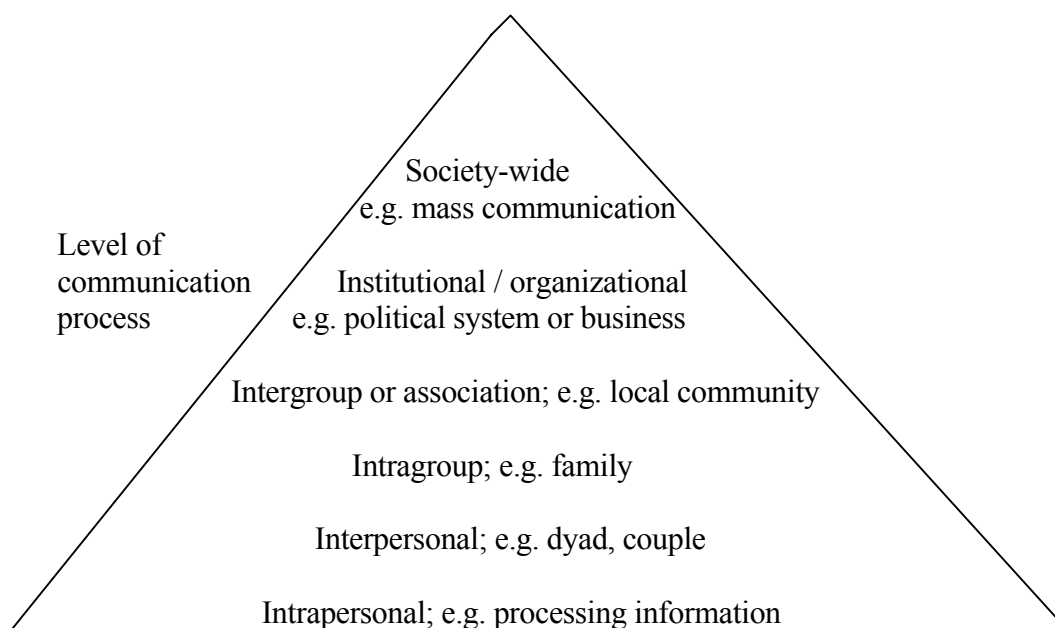


Figure 7. The pyramid of communication. (Based on McQuail, 2000, p. 10).

Risk communication tools need to be adjusted to specific frameworks since the various levels usually involve typical discourse, logic, forms and procedures. It is obvious that mass communication situations are very different from personal encounters with respect to e.g. available time, preparations and contents and the form of a message, the immediacy of feedback and the possibility to correct misunderstandings, and so forth. In this context the above model serves as an overall structure for considering the many possibilities of communications and communication contexts before going into the written text and its unique features.

The following figure, also from McQuail (2000), highlights two central factors or axes in mass communication, i.e. the information or communication process itself involving a source, a message, the distribution form or channel, and a destination or receiver. The figure also depicts the “technology” necessary to get the message across. Please note the axis endpoints of “hardware” and “software”, the former referring to equipment and engineering technologies and the latter to presentation styles or techniques, e. g. person or personality, presentation form and ability.

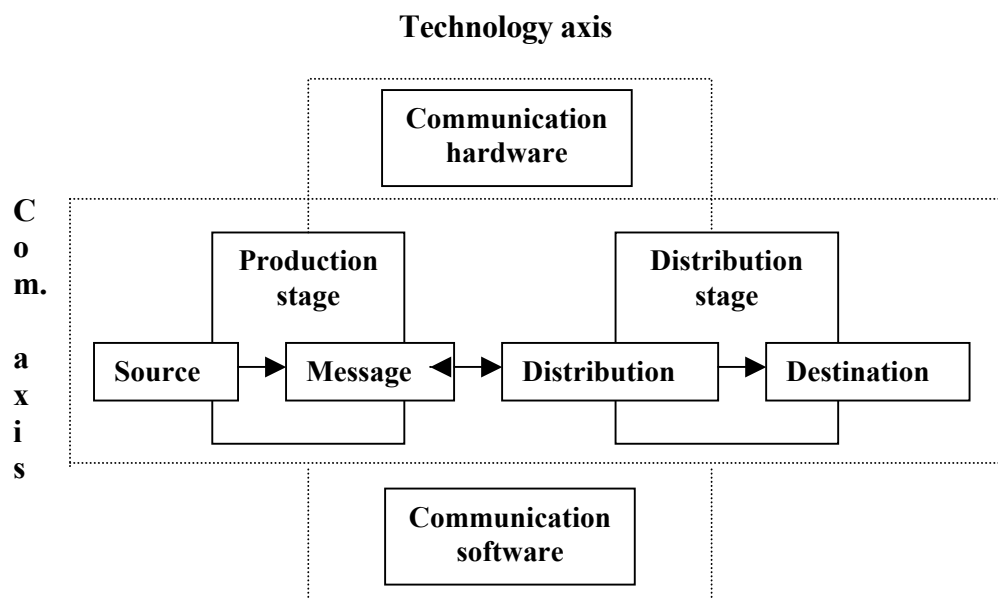


Figure 8. The communication (software) and technology (hardware) axes related to each level of mass communication. (Based on McQuail, 2000, p. 227).

However, information and communication processes basically have to do with individuals' information processing capabilities, i.e. intrapersonal information processing. This is also implied in "the pyramid of communication" figure shown above. The issue of individual process information has been presented in a comprehensive overview figure by Conzola and Wogalter (2001). The schematic steps in the figure illustrate that information from a specific source has to successfully pass the attention, comprehension, personal attitudes and belief systems, then a motivation phase before a message or instruction may result in behaviour or action (or non-action if the intrapersonal processing is unsuccessful).

The model was developed to illustrate an approach to the effectiveness of warnings in the workplace, but is here used as a generalised example of the reception and processing of risk information. Conzola and Wogalter (2001) emphasised that each of the steps in the information process can become a "bottleneck" where the process stops and the effectiveness of the message is diminished or lost.

The "source" is the sender of the risk message or information, and the "channel" represents the mode chosen for the warning or message. The channel chosen may vary from e.g. televised warnings, radio broadcasts, and written information, to personal encounters. It could also be the sounding of an alarm, the sighting of a fire, or the sensing of the earth vibrating. "Attention" to the message or signal is a necessary step in reacting to it and for the continued information processing. To catch someone's attention requires quite a lot of effort both with respect to emergencies and in everyday situations. It is necessary to place oneself, or the message, within the receiver's field of sensory input, be it visually or through sounds or tactile stimuli. Repetition diminishes the ability to attract attention, whereas novelty and surprise create interest.

The next problematic step is to maintain attention. This could be done e.g. by variation of contents so to continuously introduce some novelty, by facilitating legibility or availability of the information, etc. "Comprehension" of a message involves a great deal of cognitive

processing. There is a trade-off between completeness and brevity to consider here, and to relate to the type of situation at hand. Comprehension can be built up in several steps, and materials or messages can be developed to serve the various targeted situations in relation to the time available to process contents and the receiver's level of ability and motivation. Acute warning messages require brevity and clarity, and a content that can be interpreted at the lowest ability level in the target population or group. Information materials may well include more content and complexity.

Personal attitudes and beliefs may provide formidable hindrances relative to behavioural compliance. A message is more readily adhered to if it is in line with a person's existing beliefs. If a message contradicts, or is too dissimilar to, what a person believes or holds as true, there is a considerable risk that the message will be dismissed or neglected. However, high familiarity with a risk or hazard may also work to the opposite effect, and, for example, relax attention to the information provided due to overconfidence or complacency. It is difficult to "replace" existing beliefs (even if they can be shown to be wrong or mistaken) as well as routines or habits. This fact is often encountered when dealing with long-term health hazards or when trying to maintain compliance to high levels of safety or security. Nevertheless, credible, trustworthy, persistent and motivating information or messages may gradually alter such beliefs (see e. g. Petty & Wegener, 1998).

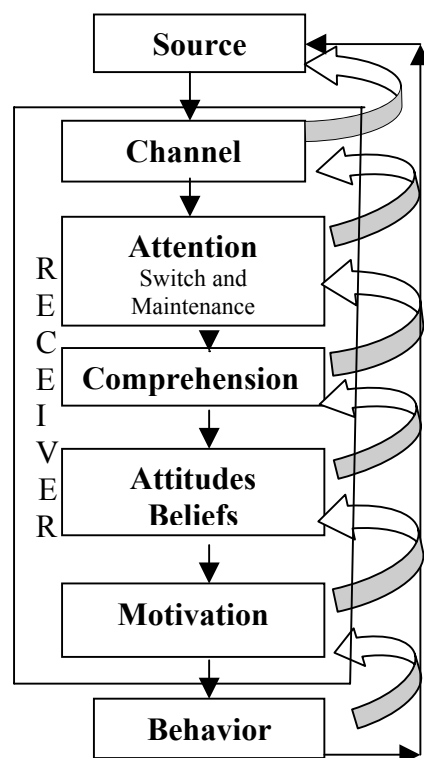


Figure 9. Communication - Human Information Processing (C-HIP) model. (After Conzola and Wogalter, 2001, p. 312).

There exists today a rather large volume of research materials that focuses on differences in risk judgements between experts and non-experts or lay people (see e.g. Sjöberg, 1998a; Sjöberg, & Drottz-Sjöberg, 2008a,b; Sjöberg, & Drottz-Sjöberg, 2009). Such materials call for more attention in risk communication research to bridge the "perception gap". Apart from differences in knowledge and familiarity with an area, or due to the specific tasks of expert

and non-expert groups, there seem to be other distinguishing factors contributing to the explanations of the differences in e.g. risk ratings between the groups, e.g. attitudes to, or interest in, various subject areas (Sjöberg, 2000).

Risk estimates and risk experiences have also been described as products within different “cultures” (see e.g. Douglas & Wildavsky, 1982; Wildavsky & Dake, 1990; Inglehart, 1990, Sjöberg, 1996, 1998b; Hansson, 1999). A “culture” provides the standards or frames of reference relative to which information and experiences are tested with respect to validity and reliability. The term “culture” is used with many different meanings, however, and the table below exemplifies what Plough and Krinsky (1987) meant by technical and cultural rationality of risk. In this context “cultural” might be interpreted to mean “social” or even “human”, as in “soft aspects” contrasted with the “hard facts” of technology.

Table 2. Factors relevant to the technical and cultural rationality of risk.

Technical rationality	Cultural rationality
Trust in scientific methods, explanations, evidence.	Trust in political culture and democratic process.
Appeal to authority and expertise.	Appeal to folk wisdom, peer groups and traditions.
Boundaries of analysis are narrow and reductionist.	Boundaries of analysis are broad, include the use of analogy and historical precedent.
Risks are depersonalized.	Risks are personalized.
Emphasis on statistical variation and probability.	Emphasis on the impacts of risk on the family and community.
Appeal to consistency and universality.	Focus on particularity; less concerned about consistency of approach.
Where there is controversy in science, resolution follows status.	Popular responses to scientific differences do not follow the prestige principle.
Those impacts that cannot be uttered are irrelevant.	Unanticipated or unarticulated risks are relevant.

It is well known that different “cultural frameworks” may influence ideas about communication and the presentation, and perception, of information. The existence of various frames of reference certainly complicates the tasks of information presentation and communication. Even more intricate aspects of these processes, however, lie in the uncertainty characteristics or the uncertainty surrounding certain hazards and in the many inter-individual differences involved.

Communicating risk and uncertainty involves several challenges. One of them is the different definitions used in various theoretical fields. In the area of “risk research” a difference between “risk” and “uncertainty” is often pointed out. The academic (e.g. game theory) and risk-analytic fields usually distinguish between “risk” as a future outcome with a known probability in contrast to “uncertainty”, i.e. a future outcome with an unknown probability. The former case can be exemplified by the throwing of a dice, where only six possible outcomes exist, although one cannot know which outcome will be shown in the next game.

With respect to uncertainty there is an absence of information of possible future outcomes, information that may or may not be obtainable (Rowe, 1994).

To make matters a bit more complex, one could add the concept of “variability” to these often used “risk” concepts. Here, it represents inter-individual differences. Acknowledging that the figure below is crude and the concepts inadequately explained, the intention is to visualise the three different concepts.

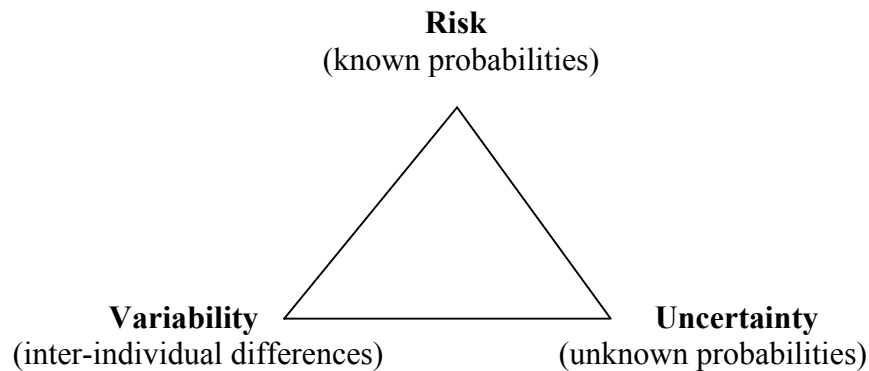


Figure 10. A graphic representation of three distinct concepts that sometimes are used interchangeably without consideration of their different meaning or content.

Rowe 1994 (as summarised by Schneider et al., 1998) considered *uncertainty* more closely and identified four such dimensions inherent in any *decision making process*:

1. Temporal uncertainty (in both past and future states),
2. Structural uncertainty (due to complexity),
3. Metrical uncertainty (in measurement), and
4. Translational uncertainty (derived in explaining uncertain results).

These dimensions can exist simultaneously. In addition, Rowe identified three primary sources of variability:

1. Underlying variants (variants inherent in natural systems contributing to the spread of parameter values, including randomness, inconsistent human behaviour and chaotic or non-linear dynamic systems behaviour),
2. Collective/ individual membership assignment (the distinction between collective behaviour and a single instance of behaviour for a parameter), and
3. Value diversity (varying perspectives and value systems among people), (see Schneider et al., 1998, p. 170). The three sources of variability can contribute to uncertainty in each dimension mentioned above.

The combination of the previously mentioned four dimensions of uncertainty and the three types of variability are shown in Table 3 (based on Rowe, 1994 and Schneider et al., 1998, although not presented by these researchers). In this context the table only aims at illustrating the richness of contents of those concepts which ought to be considered in risk communication situations. Hopefully Robyn Dawes' (1988, p. 272) words will be of consolation if the risk communication task appears too complex: “Without uncertainty, there would be no hope, no ethics, and no freedom of choice.”

Table 3. A cross-tabulation of three primary sources of variability and four dimensions of uncertainty.

Primary sources: VARIABILITY	Dimensions of UNCERTAINTY			
	Temporal (past & future)	Structural (due to complexity)	Material (in measurement)	Translational (derived in explaining uncertain results)
Underlying variants	Spread of parameter values, randomness, inconsistent human behaviour, chaotic or non-linear dynamic systems behaviour.			
Collective/ Individual membership assignments	Distinction between collective system behaviour and a single instance of behaviour for a parameter.			
Value diversity	Varying perspectives and value systems among people.			

A few words ought to be included here about vagueness, ambiguity, generality and fuzzy qualifiers, because language use and choice of terms may cause considerable confusion in risk communication. Qiao Zhang (1996) stated that fuzziness differs from generality, vagueness and ambiguity in that it is inherent, and not simply a result of a one-to-many relationship between a general meaning and its specifications. Fuzziness is inherent in the sense that it has no clear-cut referential boundary, and is not resolvable with resort to context. A few explanations and definitions follow:

- *Fuzziness*: An expression is fuzzy if it has a characteristic of referential opacity, as in, for example, *about 20 students*. Is 14 the boundary of *about 20*? The answer varies from context to context, from individual to individual, depending on their experiences, their world knowledge and their beliefs.
- *Generality*: The meaning of an expression is general in the sense that it does not specify certain details. The meaning of *city* is general because it does not specify whether the city is big or small, modern or ancient.
- *Vagueness*: Vagueness is defined as an expression which has more than one possible interpretation. For example *good* has several interpretations; good weather, good people, good legs, good student.
- *Ambiguity*: Ambiguity is defined as expressions which has more than one semantically meaning. An expression is ambiguous if it has several paraphrases which are not paraphrases of each other.

Zhang concluded that *fuzziness* has little to do with misuse. It differs from ambiguity, generality and vagueness in that it refers to an indeterminate referential boundary. This conclusion opposes the conventional notion that (all) these concepts represent “bad things” or imprecision in language. All three concepts, and fuzziness in particular, instead play a unique role in language communication according to Zhang, who also underlined that fuzziness is closely involved with language users’ judgements.

Lehto, House and Papastavrou (2000) studied safety standards as examples of fuzzy qualifiers in messages to be used in warning signs, labels, material safety data sheets and other sources of safety information. They focused on documenting workers understanding of adverbial or adjective phrases in hazard communications using fuzzy sets. In all, 353 workers at 9 locations were asked to interpret the meaning of hazard communication phrases, containing fuzzy qualifiers such as safe, weak, strong, prolonged, extremely, slightly, poorly or adequate. The messages used were short fragments of sentences that described actions or conditions. Several linguistic variables, i.e. *qualifiers*, and contexts were identified for commonly used hazard communication phrases. Their experiment revealed that the inclusion of *contextual information* almost always caused large, easily explainable, shifts in the membership functions (e.g. meaning, understanding). The data thus showed that both qualifiers and contextual variables influenced the obtained membership functions. In a minority of the cases, the obtained membership functions were unaffected by contextual information. The results of the study supported the notions that workers can interpret linguistic variables in reasonable ways. It also concluded that training of workers’ *knowledge can reduce the need to provide contextual information*. The results furthermore indicated that fuzzy set theory can be a useful tool for quantitatively documenting workers responses to hazard communication phrases.

Finally, we would include a comment and a few references related to numerical expressions and their translations. It is often mentioned that numerical probabilities are difficult to communicate and to understand. There are several types of problems related to communicating numerical information. Some aspects concern the presentation of *statistical information*, e.g. in words or numbers (10^{-6} , or one in a million), another aspect relates to how information should be understood or interpreted. For example, what does it mean in real life? Will one person in a million be hurt or die? Who? When? How do you know? Numerical information may be transformed into words or expressions, but to explain theoretical reasoning on probability is a major challenge in the context of risk communication. In the latter case educational efforts and good pedagogical examples may be helpful.

The situation is not unproblematic, however, regarding the comprehension of verbal probability expressions. The table below gives an overview of Theil’s (2002) results from a meta-analysis of (the few available) studies where researchers had asked people to put numbers to various quantifying words such as “rare”, “unlikely”, “frequent” and “probable”. Each column represents an empirical study. Empty spaces indicate that the expression was not included in the study or could for other reasons not be compared.

Theil transformed all the scales used into one single scale for comparison reasons, which ranged from 0-100. As can be seen in the table, the results showed substantial variations between the ratings presented in the studies. For example, the expression “rare” was, on average, rated from 5.0 to 14.0, and “possible” between 27.0 and 55.0.

Table 4. Mean ratings[#] for verbal probability expressions. (From Theil, 2002, p.181).

Expression	Cl	Ha	Ja	Ke	Ko	La	Li	P1	P2	Ta
Rare	14.00	11.90	5.00	5.30	-	-	7.00	-	-	13.81
Very unlikely	-	15.90	10.00	-	-	-	9.00	-	-	28.44
Unlikely	24.00	-	19.00	-	14.00	18.53	18.00	-	-	31.42
Possible	55.00	-	-	-	27.00	33.47	37.00	44.40	47.10	-
Likely	-	-	77.00	-	63.00	67.18	72.00	67.30	69.50	-
Probable	67.00	-	-	-	64.50	65.00	71.00	-	-	74.66
Good chance	71.00	72.30	-	-	-	-	74.00	-	-	82.18
Frequent	74.00	-	78.00	-	56.00	-	-	-	-	81.16
Usually	72.00	-	-	75.90	-	-	77.00	-	-	73.71
Very probable	79.00	83.50	-	-	-	-	87.00	-	-	82.50

[#] The columns in the table present values from a number of studies, these are: Cl= Clarke et al., 1992; Ha= Hamm, 1991; Ja= Jablonowski, 1994, Ke= Keeney, 1981; Ko= Kong et al., 1999; La= Laswad and Mak, 1997; Li= Lichtenstein and Newman, 1967; P1= Pellissier and Van Buer, 1996; non-entrepreneurs; P2= Pellissier and Van Buer, 1996; entrepreneurs; Ta= Tavana et al., 1997.

Information on risk and probabilities is often difficult to communicate due to different background knowledge and because everyday language does not correspond precisely to mathematical or statistical information. Presentations of statistics and quantitative risk information therefore require that great care is taken to ensure that the message is adequately interpreted. This concerns both the use of language and the communication of the conceptual content. The task is not easily approached or solved. It is sometimes suggested that comparisons could facilitate comprehension, and if appropriate comparisons can be made it certainly may help to communicate a message. However, comparisons may trigger other irrelevant or unintended associations which add to confusion rather than help in clarifying the initial message. It is therefore suggested that lay people and experts from various fields are engaged in commenting on information or presentation materials prior to publication, or their use in public meetings. It is also suggested that researchers related to the NWM field take a closer look at the often underlined recommendation from the international focus group that information materials must be presented “at the right level”.

8. References

- Clarke, V., Ruffin, C., Hill, D. & Beamen, A. (1992). Ratings of orally presented verbal expressions of probability by a heterogeneous sample. **Journal of Applied Social Psychology**, **22**(8), 638-656.
- Conzola, V. C., & Wogalter, M. S. (2001). A Communication-Human Information Processing (C-HIP) approach to warning effectiveness in the workplace. **Journal of Risk Research**, **4**, 309-322.
- Dawes, R. M. (1988). **Rational choice in an uncertain world**. Fort Worth: Harcourt Brace College Publishers.
- Douglas, M. & Wildavsky, A. (1982). **Risk and Culture**. Berkeley, CA.: University of California Press.
- Drottz-Sjöberg, B.-M., Richardson, P., Engen, O. A., & Přítrský, J. (2008) *Assumptions and considerations underlying current approaches in nuclear waste management*. ARGONA-report. Arenas for risk governance. FP6-036413. Deliverable D5. Date of issue: 04/01/2008.
- Drottz-Sjöberg, B.-M. (2003). Introduction to risk communication. Current trends in risk communication: theory and practice. On Line Report. Oslo: Directorate for Civil Defence and Emergency Planning.
- Hamm, R. (1991). Selection of verbal probabilities: A solution for some problems of verbal probability expression. **Organizational Behavior and Human Decision Processes**, **48**, 193-223.
- Hansson, S. O. (1999). A philosophical perspective on risk. **Ambio**, **28**, 539-542.
- Inglehart, R. (1990). **Culture Shift in Advanced Industrial Society**. Princeton, NJ.: Princeton university Press.
- Jablonowski, M. (1994). Communicating risk: words or numbers? **Risk Management** **41**(12), 47-50.
- Keeney, R. (1981). Between never and always. **New England Journal of Medicine**, **305**(18), 1097-98.
- Kong, A., Barnett, O., Mosteller, F., & Youtz, C. (1999). How medical professionals evaluate expressions of probability. **New England Journal of Medicine**, **315**(12), 740-744.
- Laswad, F., & Mak, Y. (1997). Interpretations of probability expressions by New Zealand standard setters. **Accounting Horizons**, **11**(4), 16-23.
- Lehto, M., House, T., Papastavrou, J. D. (2000). Interpretation of fuzzy qualifiers by chemical workers. **International Journal of Cognitive Ergonomics**, **4**, 73-86.
- Lichtenstein, S., & Newman, R. (1967). Empirical scaling of common verbal phrases associated with numerical probabilities. **Psychonomic Science**, **9**(10), 563-564.
- McQuail, D. (2000), **McQuail's Mass Communication Theory**. 4th edition. London: SAGE.

- Pellissier, J., & Van Buer, M. (1996). Entrepreneurial proclivity and the interpretation of subjective probability phrases. **Journal of Applied Business Research**, *12*(4), 129-137.
- Petty, R. E., & Wegener, D. T. (1998). Attitude change: Multiple roles for persuasion variables. In D. T. Gilbert, S. T. Fiske., and G. Lindzey (eds.), **The Handbook of Social Psychology** Vol. I. (pp, 323-390). Boston: McGraw-Hill.
- Plough, A., & Krinsky, S. (1987). The emergence of risk communication studies: Social and political context. **Science, Technology, & Human Values**, *12*, 4-10.
- Rowe, W. (1994). Understanding uncertainty. **Risk Analysis**, *14*, 743-750.
- Schneider, S. H., & Holly Morehouse Garriga, B. L. T. (1998). Imaginable surprise in global change science. **Journal of Risk Research**, *1*, 165-185.
- Sjöberg, L. (1996). A discussion of the limitations of the psychometric and Cultural Theory approaches to risk perception. **Radiation Protection Dosimetry**, *68*, 219-225.
- Sjöberg, L. (1998a). Risk perception: experts and the public. **European Psychologist**, *3*, 1-13.
- Sjöberg, L. (1998b). World views, political attitudes and risk perception. **Risk-Health, Safety and Environment**, *9*, 137-152.
- Sjöberg, L. (2000). Factors in risk perception. **Risk Analysis**, *20*, 1-11.
- Sjöberg, L., & Drottz-Sjöberg, B.-M. (2008a). Attitudes towards nuclear waste and siting policy: Experts and the public. In Arold P. Lattefer (Ed.) (pp. 47-74), **Nuclear Waste Research: Siting, Technology and Treatment**. New York: Nova Science Publishers.
- Sjöberg, L. & Drottz Sjöberg, B.-M. (2008b). Risk perception by politicians and the public. **Energy & Environment**, *19*, No 3+4, 455-485.
- Sjöberg, L., & Drottz-Sjöberg, B.-M. (2009). Public risk perception of nuclear waste. **International Journal of Risk Assessment and Management**, *11*, No.3/4, 264-296.
- Tavana, M., Kennedy, D., & Mohebbi, B. (1997). An applied study using the analytic hierarchy process to translate common verbal phrases to numerical probabilities. **Journal of Behavioral Decision Making**, *10*(2), 133-150.
- Theil, M. (2002). The role of translations of verbal into numerical probability expressions in risk management: a meta-analysis. **Journal of Risk Research**, *5*(2), 177-186.
- Wildavsky, A., & Dake, K. (1990). Theories of risk perception: who fears what and why? **Daedalus**, *119*, 41-60.
- Zhang, Q. (1996). Fuzziness – vagueness – generality – ambiguity. **Journal of Pragmatics**, *29*, 13-31.