# Electromagnetic Field Exposure:
# Risk Communication in the context of Uncertainty


**Edited by**

*Carlos del Pozo*
*Demosthenes Papameletiou*
*Peter Wiedemann*
*Paolo Ravazzani*
*Emilie Van Deventer*



EIS-EMF Project: European Information System on Electromagnetic Fields Exposure and Health Effects


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Effects of the exposure to
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# Foreword

This book is based on the contributions to the 2nd Workshop on EMF Risk Communication on May 2-4, 2007, in Stresa, Italy. The Workshop was organized by the Physical and Chemical Exposure unit of the Institute of Health and Consumer Protection of the Joint Research Centre of the European Commission, as part of its activities within the FP6 EMF-NET Co-ordination Action, and in collaboration with the World Health Organisation, International EMF Project. The Society for Risk Analysis also collaborated with the workshop by promoting a call for papers among its members.

The focus of the workshop was to address the specific challenges of communicating 'possible' health risks from exposure to low-level non-ionising EMF radiation (the so-called "non-thermal" effects). In particular to look at the uncertainty in EMF risk assessment and characterization – and even in hazard identification – and ways for better involve, inform and educate the public.

Arguably a distinctive characteristic of exposure to low level non-ionising EMF is the inability of the scientific community to clearly identify and quantify the health risks. In this context "possible" risks, although supported by best scientific knowledge, are uncertain in the sense they are a matter of conjecture – and not established "potential" risks waiting to happen.

There is ample agreement among experts in Europe and worldwide that scientific evidence on possible adverse health impacts from exposure to EMF fields below the ICNIRP (1998) limits is still insufficient and inconclusive. So far, health risks have not been clearly identified and quantified, and thus risk assessment and risk characterization remain highly uncertain. In these circumstances, and consistently with the strategy adopted by the WHO, the European Commission, and other national authorities and independent international institutions, it is necessary to support further research in this area to fill-out knowledge gaps, and to periodically review and update the exposure limits according to the best available scientific knowledge.

An opinion broadly shared by the participants at the Workshop was that EMF risk communication in the context of uncertainty is an ongoing challenge requiring mutual trust, transparency, accurate information, consultation and dialogue. Participants recognised that public perception of risk is being influenced, and at times misled, by contradictory and often inaccurate sources of information.

Much more needs to be done to better inform the public and to promote public understanding based on sound scientific evidence, especially in the area of exposure to RF fields from mobile phone base stations, and the new EMF and wireless applications. Risk communication should provide accurate and readily understandable information, and encourage public participation and dialogue to help the decision-making process reaching a balanced judgement that takes on board people's concerns and interests.

The Editors

# Introduction

## Exposure to Low-level EMF and Possible Health Impacts: Risk Communication and Uncertainty

C. del Pozo, D. Papameletiou, P. Wiedemann, P. Ravazzani, and E. Van Deventer

### General remarks

Exposure to low-level non-ionising electromagnetic fields of man-made origin is, nowadays, an unavoidable fact of life. The pace in the development of EMF technologies is breathtaking, and the number of commercial applications and users ever increasing. In hand with these developments, as shown by the European Commission EUROBAROMETER results of June 2007, public concerns about possible risks from exposure to electromagnetic radiation have grown in recent years.

Member states in the EU follow the Council Recommendation (EC99/519), limiting the public exposure to EMF (in the 0 Hz to 300 GHz frequency range), which apply the guidelines on maximum exposure levels and reference values established by ICNIRP (1998). Exposure limits are based on peer-review of the scientific evidence on established health effects, and apply to all devices emitting EMF. The basic requirement is that below these limits health must not be affected, even to repeated exposure. So far no health effects have been consistently demonstrated at exposure levels below the ICNIRP limits (1998) but scientific understanding of possible adverse health impacts from exposure to very weak EMF fields remains insufficient and inconclusive. In particular concerning exposure to magnetic fields of extreme low frequencies, and long-term (more than 10 years) exposure to radio frequency fields.

Recent opinions of the Scientific Committee on Environmental and Newly Identified Health Risks (SCENIHR), adopted on 21 March 2007 and on 19 January 2009, did conclude that for radio and intermediate frequencies, and static fields no health effects have been consistently demonstrated at exposure levels below the ICNIRP-limits. For intermediate frequencies and static fields the data is limited and more research is considered necessary. In the case of long-term exposure to RF fields, over more than 10 years, the epidemiological data is insufficient to completely rule out any possible health effects. As for residential exposure to extremely low frequencies (ELF), research on biological mechanisms should be pursued to explain the possible epidemiological association between quasi-static magnetic fields (above 0.4 micro Tesla) from power lines and childhood leukaemia [as stated in the IARC (2002) evaluation, and updated at WHO Fact sheet N°322 June 2007]. These conclusions are in full agreement with other recent evaluations and consultations carried out by the WHO, and the EC-supported EMF-NET project, and various independent national institutions in Europe and worldwide.

### Possible risks and uncertainty

Arguably a distinctive characteristic of exposure to low-level EMF is the inability of the scientific community to clearly identify and quantify potential health risks (Wiedemann and Schütz 2008). In this context risks are “possible” risks, i.e. a matter of reasonable

scientific conjecture, rather than established risks. Unfortunately in this case, risk assessment and risk characterization – and even hazard identification – remain highly uncertain. Possible risks can only be characterised qualitatively using descriptors not exempt of subjectivity and ambiguity (see Hyland 1998).

Verbal risk scales using expressions such as: “almost no chance,” “very unlikely,” “unlikely,” “moderate chance,” “likely,” “very likely,” “almost certain” might be quite differently understood. Thus, experts but not laypeople may agree on the interpretation of the four-point scale of the IARC classification[1]: "Sufficient evidence", "Limited evidence", "Inadequate Evidence", "Evidence suggesting lack of effect".

Qualitative risk information expressed in a verbal scale or in numerical form as degrees of belief or subjective probabilities will therefore result in different interpretations and conclusions. Moreover, as mentioned by Neil Weinstein (in this book) even in the case of established risks it is extremely difficult to convey probability information to the general public, and no verbal risk terms are satisfactory for communicating quantitative risk information, and thus still less for communicating qualitative risk information.
The assessment of established risks, as well as of “possible” risks is therefore important to the regulatory process. No matter how small potential health hazards might be – in some cases they could represent a serious public health threat because of the sheer size of the population exposed. In these circumstances, and consistently with the strategy adopted by the WHO concerning exposure to electromagnetic fields, the European Commission, and various other national and international bodies, there must be a continuous support of research in this area to fill-out knowledge gaps, and to periodically review and update the exposure limits according to the best available scientific knowledge. Further precautionary measures must be the result of a broad consensus when reasonable doubts of possible harm are supported by sound scientific arguments.

**The WHO handbook: Establishing a Dialogue on Risks from Electromagnetic Fields**
The starting point of the 2nd Workshop on EMF Risk Communication on May 2-4, 2007, in Stresa, Italy, was the WHO handbook on "Establishing a Dialogue on Risks from Electromagnetic Fields", published in 2002. This document provided the framework for the workshop panel discussions and for the evaluation of the risk communication case studies. All participants were invited to critically review and apply this framework when preparing their contributions.

Concerns over possible health risks from exposure to electromagnetic fields associated with power lines or mobile phone base stations led to the preparation of the handbook. Such risks present difficult challenges for decision-makers, first of all as mentioned in the previous section, determining if there is a hazard from EMF exposure and what the potential health impact is. The handbook basic purpose is to support the decision-making process, which must face a combination of public controversy, scientific uncertainty, and the need to operate existing facilities and/or the requirement to site new facilities appropriately. To help reducing misunderstanding and improving trust through better dialogue.

Responding to these challenges requires the involvement of individuals or organizations with the right set of competencies, combining relevant scientific expertise, strong

[1] http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=cmed.section.5128

communication skills and good judgment in the management and regulatory areas. There is a firm believe that implementing community dialogue successfully helps to establish a decision-making process that is open, consistent, fair and predictable. Participation will not necessarily lead to consensus but it may reduce tension and improve the general climate for debate. It might help to establish a platform for exchange different views. It can also help achieve the timely approval of new facilities while protecting the health and safety of the community.

**Effective risk communication: Participation, information and public understanding**

This book is based on the contributions to the 2nd Workshop on EMF Risk Communication. The workshop consisted of plenary talks by leading experts from Europe and the USA presenting a comprehensive update of current thinking on these topics, as well as the presentation and discussion of EMF-related "case studies" developed on behalf of national authorities, non-governmental bodies, and industry. The presentation of case studies was grouped in four discussion panels: "Information", "Education", "Measurements" and "Participation". Documents of the Workshop, abstracts and presentations are available at the workshop website.

After this introduction, the book is divided in two parts. The first part presents contributions looking at various aspects of risk communication from both methodological and applied studies. They give the perspective of risk research experts concerning the topics of "Science, risk and communication", "Characterising and assessing uncertainty", "Risk perception challenges", and "Participation, information and public understanding". After these papers, the second part of the book presents a selection of "case studies" discussed during the Workshop.

In the lines that follow we introduce briefly the contributions included in the first part of the book.

The paper, "The building blocks of risk communication", by Peter Wiedemann discusses the differences in the perception of risk by laypersons and experts and their different approaches to risk communication and information. He presents a concise view of the various phases in the lifecycle of a risk issue: the latency phase, where the risk is not yet a subject of public awareness; the emergence phase where the risk becomes a problem; and the phase of crisis triggered by a critical event. In the final phase, the risk issue is tackled and controls and regulations are set in place. He also develops in more detail what on his opinion are the three building blocks of risk communication: The quality of the relationships between all those involved, the design of the information, and the modelling of the dialogue. In Wiedemann's contribution these three building blocks for good risk communication are described, options are outlined and supportive as well as critical evidence from empirical studies on risk perception and communication are reported. He argues that the purpose of risk communication is to discuss risks, to conduct a topic-orientated, fair debate about differences in risk assessment, and to find solutions to conflicts about risks. But he points out that it would be a mistake to believe that these aims could be achieved just by supplying information. In his view, risk communication must provide concrete proposals and a well-defined platform for the dialogue between all concerned parties, and one-sided information that takes no notice of the concerns of the other participants is not a basis for successful communication.

The paper by Silvio Funtowicz, "Models of Science and Policy: From expert demonstration to participatory dialogue" argues that as science-related policy issues have come to be recognised as complex and more inherently difficult of solution, the conception of the role of science has also developed and matured. That nowadays when science is deployed in the policy context, we are aware of the possibility that facts are uncertain, values in dispute, stakes high, and decisions urgent. He discusses briefly the evolution of several conceptual models of the relationship between science and decision-making in policy processes: 1) The 'modern' model (perfection/perfectibility), 2) Precautionary model (uncertain and inconclusive information), 3) Framing (arbitrariness of choice and possible misuse, 4) Demarcation (possibility of abuse of science), and 5) Extended participation. He argues that a re-thinking of the relationship between science and policy (and indeed politics) is called for. The recognition that in many policy issues irreducible scientific uncertainty and complexity requires a fundamental revision of our definitions of knowledge, as well as governance. In this view, knowledge is not only produced by science and governance is more than deducing action from facts and preferences.

The contribution by Lennart Sjöberg, "EMF hazards and principles of risk perception" points at three areas of risk perception: General and personal risk, demand for risk mitigation or policy attitudes, and the role of emotions. He looks at data from three different samples from the Swedish population concerning risk perception associated with three main EMF applications: Transmission lines, mobile telephones, and base stations. The results of his analysis show that personal and general risks of the EMF hazard differ in a way typical of lifestyle risks: Larger general than personal risks, and general risk more important for policy demands than personal risk. According to his results, people sees mobile phones as equally risky as base stations, and rates it as less risky than transmission lines. He argues that for mobile telephones emotions, especially fear and worry may account for a sizable share of the perceived risk. In the case of transmission lines he found that public demand for risk mitigation was moderately well accounted for by a regression model where preoccupation with the risk, and general risk, were the most important predictors.

Neil Weinstein in the following paper, "How Does the Public Think About Risk? Issues in Risk Perception and Risk Communication", examines some issues that arise in the transmission and comprehension of risk information. As he puts it, other that the all-important social and political factors; the attention, education, numeracy, experience of the audience, its cognitive biases, and the complexity and formatting of information all influence the success of communication. Even if he acknowledges that the seven-point verbal risk scales (such as, "almost no chance," "very unlikely," "unlikely," "moderate chance," "likely," "very likely," "almost certain") may be the best for eliciting the public's perceptions of risk probabilities, he argues that verbal risk terms are not satisfactory for communicating quantitative risk information, and there is still a need to present risk probabilities to the public in numerical form. He concludes that people do have cognitive limitations, and sometimes have biases that prevent them from evaluating information objectively. But they can also show an impressive sophistication and an ability to incorporate many factors into their decisions.

In the paper that follows, "Layperson's perceptions of the characterisation of uncertainties", Andrea Thalmann discusses laypersons' understanding of different numerical and verbal uncertainty descriptions, putting special emphasis to recent results

regarding laypersons' understanding of different standardized sets of evidence labels. She mentions that verbal evidence categories used in HF EMF risk characterization are often neither clear nor comprehensible, and recent data indicates that the context in which these verbal evidence categories are embedded bears a serious impact on laypersons' understanding of the existing power of evidence, too. She points out that contradicting general expectations, an explicit definition of these verbal evidence categories might enhance laypersons' understanding only to a limited degree. She argues that communication tools have to be evaluated in the light of their clarity and their appropriateness to enhance non-experts' risk-related knowledge in order to successfully promote a better understanding of risk and risk related issues in the public.

Marie-Eve Cousin and Michael Siegrist continue with the paper, "What do Laypeople know about Mobile Communication? A Mental Model Approach", where they examine laypeople's standard of knowledge and how it is related to their risk perception of mobile communication. Why does the risk perception of laypeople differ from that of responsible experts? Is this discrepancy due to different standards of knowledge? What do laypeople normally know about mobile communication? They applied the 'Mental Model Approach' to show how lay mental models of mobile communication differ from those of experts, with view to the improvement of communication between these two groups. Their methodology included three steps: First, an expert model reflecting experts' understanding of mobile communication was created (from literature review and open-ended interviews with 16 experts), second this model was used as the basis for semi-structured interviews with 31 laypeople, and third a mail survey to determine the prevalence among Swiss citizens (N=775) of the different beliefs about mobile communication identified in the interviews.

The paper that follows, "Information campaigns and public understanding: the example of mobile telecommunications", by Julie Barnett and Lada Timotijevic, explores the effects and the meaning of information provision around the possible health risks of mobile telecommunications in the United Kingdom. They report on the analysis of data from a survey conducted as part of a programme of research commissioned by the Mobile Telecommunications Health Research Programme (MTHR) in the UK - exploring public awareness of two leaflets produced by the Department of Health. In this contribution, the analysis is based on data generated by a series of focus groups exploring public understandings of uncertainty and precaution around the possible risks of mobile telecommunications.

In the next contribution, "Understanding Controversies Related to Emerging Risks", Olivier Borraz and Danielle Salomon put forward the thesis that the emergence of risk issues is inherently a dynamic political and social process, with public authorities, international organisations, and private operators having a limited understanding of how risks issues emerge. That this often leads them to make the false assumption that the controversy derives from the introduction of a new technology within a population that lacks scientific education, that is lacking information, that behaves irrationally, that responds emotionally, that needs more time to adapt, that demands to participate in decisions on new technologies, or that is misinformed by activists spreading false information. The authors argue that the situation calls for research aimed at providing specific knowledge on the factors that may contribute to the emergence of risk issues, and this may only be done if within regulatory processes a prior distinction is made

between risk management and risk issue management. They mention two basic objectives in this contribution, first to defend the need for a framework of analysis applied to controversies on emerging risks, and second to suggest, as they put it, more effective risk communication strategies – prying loose from traditional approaches based on measures of risk perception or public understanding of science.

The following contribution by Paolo Crivellari, Bruna De Marchi, and Luigi Pellizzoni also looks at a similar subject, "The EMF controversy: insights and opportunities". They discuss the causes of public concern as well as the regulatory aspects that in their view fuel the controversy on EMF and particularly mobile phone technology. They argue that this is fundamentally the result of: (1) Public worries of the possible adverse health effects of exposure to EMF, (2) Issues of land use in the planning and deployment of base stations, and (3) A combination of individual habits and societal trends. Referring to the decision-making and regulatory bodies, they see a gradual evolution also involving three stages. In a first stage, public protest was interpreted within the framework of the 'deficit model' in the public understanding of science. In a second stage, it was acknowledged that protests were an expression of social distrust in regulatory agencies and/or elected officials. Also there was some recognition of existing uncertainties, which justify some caution in the implementation of the technology. In a final stage, some experiences of citizens' inclusion in the policy process started. The authors point out that although the level of concern about EMF is still fairly high in many countries, at present conflict seems less heated than some years ago. In their opinion a decline in the level of social conflict is not necessarily a measure of success of the public authorities. That conflict may play a positive role in drawing attention to unforeseen or underestimated consequences of present choices, raising 'early warnings', exploring and promoting options which foster technology while taking into account people's needs and interests.

Raymond Neutra, in the next paper, "The Democratic Aspect of California's Democratic Foresight Strategies for EMF: A Case Study in Stakeholder Participation", describes the contributions of the various stakeholders to the conceptualisation and conduct of the Electric and Magnetic Fields Program established by the California Public Utilities Commission and lasting nearly 8 years, from November 1993 to end 2002. The program included a stakeholders advisory group to advise on the research and policy analysis agenda. Representatives of northern and southern California citizens with concerns about health effects were members along with representatives of the investor owned and municipal utilities, the brotherhood of electrical workers, the state parent teacher's organizations, the industrial hygienist professional association, the Academy of Pediatrics and others. Among the various lessons learned he mentions that even when contentious, stakeholders' participation can be constructive in the nominating phase, and in the phase of foresight-full assessment of alternatives and precautionary research. That the expression of opposing views assures the explicitness of such topics as: fair procedural practices, the research and policy questions to be posed, the policy options to be considered and criteria by which these options are evaluated, rules for accepting evidence, etc.

The last contribution of this book's first part is, "Evolution in the social perception of risk associated with EMF in Spain" by Maria Jesús González. The author discusses the public perception of risks in Spain in the mid-2000, and the opposition to the building of antennas and to the deployment of mobile phone infrastructure. She points out that

despite the wide public acceptance of the benefits of mobile telephony there is still a broad public rejection of the infrastructure. According to her, public perception of EMF risks in Spain is being distorted because the people ignores or disregards the fact that no adverse health effects has been identified, and that this state of opinion is being nurtured, and legitimated, by some groups and "experts" enjoying social and media notoriety, but which misrepresent the scientific evidence. She mentions a number of other factors at the source of this crisis in public confidence, namely, (1) some misplaced normative institutional responses to the public concerns, (2) the absence of communication campaigns by the Spanish Health Authorities, (3) the inexistence of an independent agency or scientific institution of reference in Spain to provide information on the matter, and not least (4) the shortcomings in the industry's behaviour during the deployment of the infrastructures. The author reports that social opposition against antennas in Spain still remains despite the efforts made by the national and regional authorities to communicate the state of the science, and despite the institutional consensus reached concerning this matter.

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## The Building Blocks of Risk Communication

Peter Wiedemann
Research Centre Juelich, MUT – INB, Germany

### Introduction

Laypersons approach questions of risk differently from experts (Fischhoff et al. 1978, Slovic, Fischhoff und Lichtenstein 1980). Although they, too, ask about the possible consequences, they perceive risks primarily in social, affective terms. Risk statistics such as probability data are less important or play a completely different role here (see the literature on probability neglect, Rottenstreich & Hsee, 2002). Laypersons incorporate questions of risk into their routine perspective of the events of everyday life. This perspective is based on customary description patterns, largely shaped by the media, such as scandal stories, sensational disclosures, tragedies and disaster reports.

In short, the level of risk perception is determined in part by which risk stories gain the public's ear. Risk stories transmit simple, easy to understand arguments. In addition to the layperson's arguments, these stories cover fairness and justice, the right way to deal with the problem, view of self and others, etc. (Wiedemann, Clauberg & Schütz 2003). This means that laypersons ask about aspects that play no part in a scientific risk assessment, which, indeed, would be considered completely inappropriate in scientific circles, but which, from the layperson's perspective, are of crucial importance to perceiving and understanding risks. Risk communication must take into account these lay viewpoints in characterising risks (see Golding et al.1992, Finucane & Satterfield, 2005).

The concern for industry and governmental organizations is the mobilisation potential, i.e. the question of how rapidly, driven by what events, on what scale and among which societal groups the risk issue could develop into a problem (Kasperson et al. 1988, Pidgeon et al. 2003). Fig. 1 shows an ideal risk issue development cycle, divided into four phases. In the latency phase, the risk is not yet a subject of public discussion - there is no awareness of the problem. In the emergence phase, the risk surfaces in public discussion, i.e. as a problem. A critical event (e.g. an incident) can intensify the issue into a crisis. This is when public attention reaches its maximum. In the subsequent regulation phase, the risk becomes the subject of agreements, e.g. official regulations.

The mobilisation potential for the evolution of a problem is influenced by a number of factors. These determine to what extent a risk topic attracts public attention and to what extent it becomes politicised. It is important to note that this depends more on the lay perspective than on the risk attributes of concern to the experts. As evolution progresses, the problem becomes less and less susceptible to influence by those initially responsible for the communication (public authorities, regulators, industry). Communication can only be successful if it already attempts to influence the risk topic as early as in the emergence phase.

Various societal groups may be involved in this development. The most important groups are: politics and government, affected persons, e.g. residents, media (regional and national), the interested public and citizens' action groups, and environmental and consumer organisations, and industry.

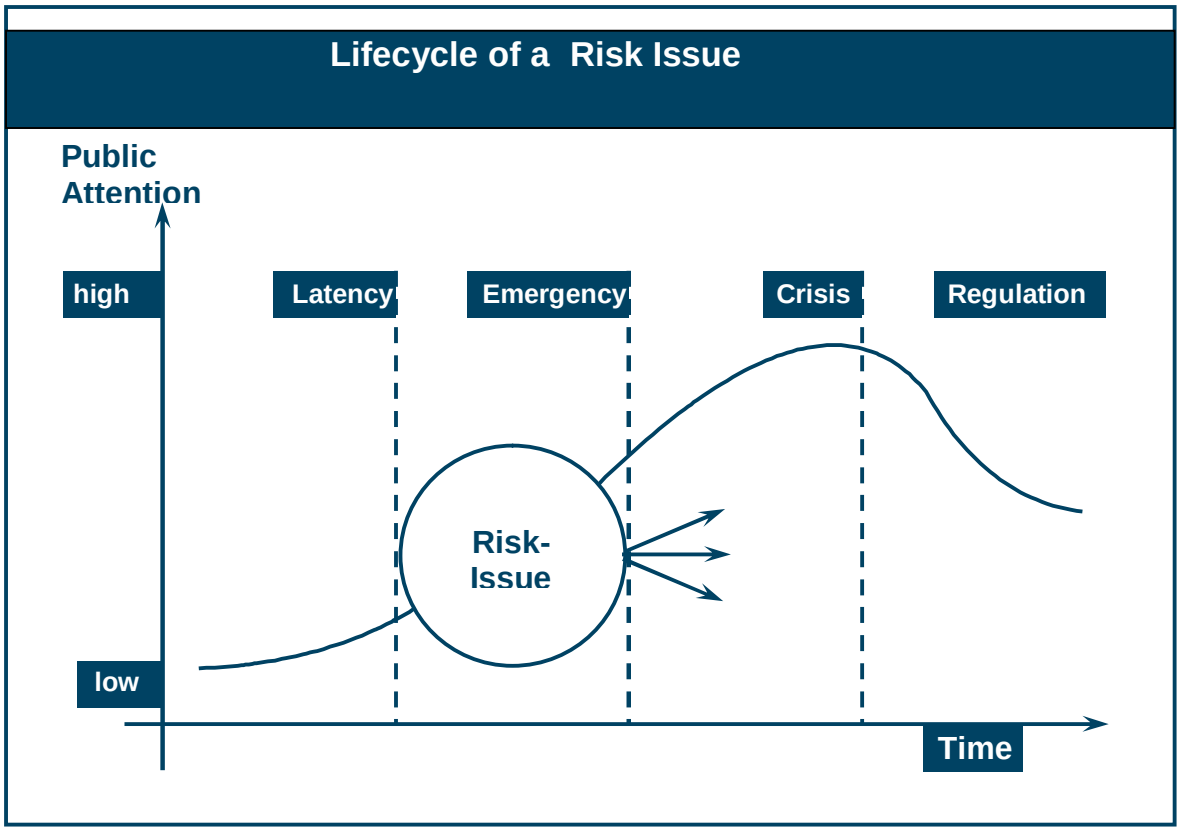


Figure 1: Risk Issue Development Cycle

In summary, the social as well as layperson's perspectives determine how the risk is associated with the organization and what image the organization has in public opinion. Thus risk communication has to address all these issues and parties that are crucial for issues and reputation management and (Heath, 1997, Larkin 2003).

**The Structure of Risk Communication**

The purpose of risk communication is to inform about risks, to conduct a topic-orientated, fair debate about differences in risk assessment, and to find solutions to conflicts about risks. It would be a mistake, however, to believe that these aims could be achieved just by supplying information about risks (Fischhoff 1995). In fact, success depends on the following three building blocks: (1) The quality of the relationships between those involved, (2) The design of the information, and (3) Modelling of the dialogue.

Without this foundation, risk communication is just patchwork. From the social aspect, the aim must be to enhance the quality of the relationship between all those participating in the communication, i.e. to develop the social backdrop for talking to each other. This involves developing perception patterns, images and self-images so as to establish a foundation for proper understanding and productive debate. Because no fruitful discussion is possible at all as long as communication is based on distrust and hostility.

In objective terms, the purpose is to broadcast facts and knowledge. It is important to convey information about the type of risk problem concerned, to minimise differences in the ways of looking at the risk, to provide aids for assessing the risk, to answer questions and to deal with objections. The essential prerequisite, however, is that the recipients must always have sufficient trust in the information provider. Only if this trust is present will it be possible to get any message across.

Whether or not the route of inviting public participation is chosen for risk communication will depend on the problem at hand, the competence of those concerned, and the confidence placed in participatory process itself.

**Building Block 1: Quality of Relationships**

The effectiveness of risk communication depends essentially on the quality of the social relationship between those taking parts in the communication. In this context, the various parties' own interests, the intentions each imputes to the others, their previous experience in dealing with one another, and their fundamental attitudes and world views all play a role (see Fischhoff 1995).

The importance of social relationships for risk communication is illustrated by the following allegory: the social relationship forms the humus on which the contents of the communication can thrive, or else the relationship is barren ground on which those contents shrivel and die. It is at the relationship level that the crucial interpretation patterns evolve, on the basis of which risk information is perceived and understood. It is at this level that the points are set for the direction the risk communication is going to take. The quality of the relationship derives from the answers to questions such as:

- Do the participants perceive the communication as open?
- Is the information flow transparent?
- Are the options for shaping the communication fair to all participants?
- Does my communication partner appreciate my own position as being serious, credible and reliable?

The objective for modelling the quality of the relationship is to build up a bond of mutual trust between the parties involved. As many experts suggest without trust, risk communication is ineffectual. Distrust - whether justified or not - is a filter that cuts out everything that does not coincide with one’s own opinion. All efforts to explain one's own viewpoint and all attempts to conduct a dialogue are then in vain (see Siegrist et al.2007).

Trusting means being able to rely either on people. One person trusts another, e.g. to provide help in an emergency, Here key is personal confidence in their acting responsibly. However, trust can also be placed in events taking their proper course. Examples here are the trust and the confidence placed in the quality and accuracy of risk analyses and in the transparency of discourse.

Risk communication involves also trust in organizations, i.e. that they not only pursue their own interests, but also show concern for public well-being and deal fairly with other stakeholder groups. In other words: competence, fairness and social responsibility are in the spotlight.

Many experts share this opinion. Slovic, obviously the most influential researcher in the field of risk perception underlines: The limited effectiveness of risk-communication efforts can be attributed to the lack of trust. If you trust the risk manager, communication is relatively easy. If trust is lacking, no form or process communication will be satisfactory." (Slovic 1993, 77). Other authors have a similar view: "Trust is arguably the most important comment of risk communication. Without public trust in authorities/regulators it is very difficult to assemble a successful risk communication strategy..." (Löfstädt 2003, 35).

However, in the last years many studies have analysed the relationship between trust und risk perceptions. They reveal a more complex picture: In a Swedish study (Sjöberg 1993) study participants were asked to assess 22 risk sources (nuclear power, AIDS, climate change etc.) with respect to perceived risk and trust. Overall, the impact of trust on risk perception was rather low; it could only explain about 10% of the variance in risk perception. Viklund (2003) in a study conducted in Great Britain, France, Spain and Sweden and Spain came to a similar result. The correlations between trust and risk perception varied in the four countries between zero and - 0.32. In a meta-analysis based on 45 studies Earle, Siegrist und Gutscher (2007) pointed out that the correlation between trust and risk perception varies between zero and -0.64. The authors came to the conclusion that context factors - such as risk knowledge - have a significant impact on the trust-risk perception relationship. Therefore, trust is not a magic tool that provides solutions for every risk communication problem. Nevertheless relationship issues are critical. Therefore it is important to communicate how the risk assessment process was organized, who was involved, and whether consultations or co-operations with other experts or stakeholders have been done. Of special importance is also whether the involved experts represented the spectrum of different scientific positions. Process matters.

**Building Block 2: Information Design**

Information and the conveyance of knowledge about risks form the material core of risk communication. Here, risk communication has two objectives. Firstly, it aims to facilitate more accurate assessment of the risk by giving information, correcting misunderstandings and providing aids to evaluation. Secondly, it has to provide feedback on public perception of the risk and answer the questions posed in this context. To achieve these aims, risk communication has to employ good communication practices as applicable to other communication contexts. The associated requirements are:

*Assess the underlying problem*

Risk communication should be based on a comprehensive consideration of the communication situation, including the diagnosis of the underlying communication problem. At least two issues have to be distinguished: Comprehension problems and conflicts about risk. There is no doubt that risk comprehension is a very important objective for risk communication. However, the attitude to view all kinds of risk communication problems as comprehension problems leads to the mistaken assumption that "educating" the public will help solve any risk issue, including conflicts about risk. If in fact the risk problem at hand is a problem of comprehension, and information centred approach to risk communication is appropriate.

If the risk problem, however, is actually a problem of conflict, education about risk is not sufficient, and insisting exclusively on an education approach might be even obstructive for conflict solving. Most often risk conflicts are based on a clash of interests or values, and do not result from comprehension deficits of one of the parties involved in the conflict. The key to conflict solution – or at least mitigation – is negotiation. Nevertheless informing about the available scientific evidence regarding a risk can be a valuable part of a negotiation process because it might help to separate scientific facts from values.

As for this the analysis of how much of the risk controversy is based on differences resulting from clashing interests or conflicts and how much it depends on actual lack of risk knowledge is a crucial diagnosis.

*Make expertise transparent*

Each scientist involved in a risk assessment process should provide basic information regarding his or her qualification. A risk assessment is based on integrating various fields of scientific expertise, for instance the EMF risk field covers dosimetry, biophysics, biology, animal research, epidemiology, as well as genotoxicology and molecular medicine etc. Thus it is very important to reveal the individual scientific competency of the involved experts. Furthermore, the expert should disclose his or her level of experience and familiarity with experimental studies and empirical investigative methods. Thorough experience and knowledge are crucial for the critical evaluation of scientific evidence. For better transparency, expert profiles could be generated and made accessible. Such profiles should not only disclose each researcher's scientific core expertise but also include their fields of professional work and the scientific bodies the researcher is associated with.

*Reveal the evaluation framework*

It is of utmost importance to disclose the standards used in weighing evidence. For example, if a scientist adopts a precautionary perspective framework for risk assessment, he or she may focus more strongly on positive than on negative results, and may put less weight on the methodological rigor of the respective studies. Others might first look at the methodological quality of a study, and only if it is sufficient take the study results into consideration. The evaluation framework, that is, the guidelines and principles on which the assessment of evidence is based, need to be made known.

In order to fully understand how a risk assessor comes to a final judgement, it is necessary to know how and by which rules the overall scientific picture is created. Such rules are not only an indispensable precondition for a consistent appraisal of evidence; they are also helpful for outsiders to understand the overall scientific picture risk characterization is based on. Such rules provide a supporting framework to deal with inconsistent findings, for instance among animal studies and epidemiology, and help to bring forth a substantiated risk judgment (see Schütz & Wiedemann 2005).

*Give the pros and cons of the judgement*

One of the critical issues in summing up evidence is the confirmation bias, i.e. the propensity to interpret studies in a way that confirms one's opinion and downplays studies, which contradict one's own beliefs. A good way to demonstrate fairness is to address explicitly both sides: the arguments speaking for the existence of a risk and the

arguments against it. This information allows not only to comparing the strength of the competing arguments but also provides a solid basis for one's own conclusion (see Schütz et al. 2008).

*Evaluate the risk communication format*

Over the last few years a small number of empirical risk communication evaluation studies have been carried out, for instance about the effectiveness of presentation formats (e.g. Burger et al. 2003; Connelly & Knuth 1998) or the influence of process characteristics (e.g. Santos & Chess 2003; Tinker et al. 2000), and others have addressed the methodological problems of empirically evaluating risk communication (e.g. Rohrmann 1992; Weinstein 1999) as well as its psychological foundations (Bostrom et al. 1994). However, most advice for risk communicators is still based on anecdotal evidence, which cannot be considered a reliable source of information. Therefore, much more effort is needed to evaluate risk communication strategies properly, so as to establish an evidence-based risk communication policy.

**Building Block 3: Modelling the Dialogue**

Many institutions in the field of risk analysis and management underline the special importance of stakeholder dialogues and participatory decision-making (National Research Council 1996, WHO 2004). Fig. 2 gives an overview of the procedures that can be used to model a dialogue. These procedures differ in terms of the rights they grant to members of the public or interest groups. These rights extend from the right to information up to the right to participate in decisions.

In the first stage, the public is given the right to information. For example, people are informed about projects in good time and are able to inspect the associated documentation. Information should be provided actively, not just on request (stage 1). A more comprehensive form of communication enquires about the concerns of the parties affected and specifically addresses their wishes, reservations and ideas, e.g. about the suitability of the site for the planned installation (stage 2). Finally, the procedure may incorporate opportunities for public participation in decision-making (stage 3).

| | | |
|---|---|---|
| | **Make recommendations**<br><br>**Ascertain concerns** | **Participation in decision-making** |
| **Right to information**<br><br>Information | Dialogue | Participation |
| **Stage 1** | **Stage 2** | **Stage 3** |

Fig.2: Procedures for modelling dialogue

*Procedures for actively providing information to the public*
Normally, allowing the public to inspect the planning and operating documents provides the information the public needs to be able to establish an adequate knowledge basis. However, technical information is usually difficult to understand, and the layperson will need a lot of time to find the points or problems of interest to him. So other measures are necessary. These could be informative brochures, lectures by experts, giving the public opportunities to question the experts, information stands on site, or open days.

*Procedures for ascertaining citizens' concerns*
One important step in communication is to identify public perspectives, attitudes, concerns and reservations. Knowing these will help in matching risk communication to the public's needs. It also helps to tone down the conflict or to avoid one completely, if the risk topic is still at an early stage of development. There are various ways to ascertain these concerns:

Focus groups are discussion groups chaired by a facilitator. Proceeding from a central theme, a discussion on an interesting risk topic is stimulated. There are no restrictions on the participants. They are free to give their opinions and views on the points discussed. In this way, a picture of their risk perception can be built up and key points identified for risk communication.
Surveys are usually based on standardised questionnaires. These are either filled in by an interviewer in direct contact with the interviewee, or can be mailed or used as the basis for a telephone survey.

*Procedures for formulating options and making recommendations*
A further option for modelling dialogue is to invite the public to participate in evaluating alternatives and in making recommendations for decision. This involves not just information but active debate bringing together different viewpoints. Such procedures can be judged by the extent to which they promote fairness and the acquisition of knowledge. Fairness means giving everybody the same right to participate, the same right to information, and the same rights in discussing and assessing decision options. Knowledge in this case is the knowledge required for assessment of the risk.

In a citizens' jury, selected citizens are charged with making recommendations. About 15 to 25 representative citizens are usually selected at random as jurors. The aim of the jury is to draw up a citizens' opinion report on the problems presented. The jurors are paid expenses for their efforts. Further costs may arise if the jury calls in experts to assist it in becoming acquainted with the subject matter. This is one way of enhancing the jury's expertise.

An advisory board generally comprises representatives of social interest groups. Any group affected or interested in the procedure can participate. This does justice to the criterion of fairness. The board generally has some specialist knowledge. Here again calling in experts can enhance competence in the specific subject.

*Procedures for public participation in decisions*
Such procedures go beyond a dialogue. They are aimed at involving the public in the decision-making process. This requires the participants to be adequately informed to be able to make a competent contribution to the process. Any deficits in their information status must be eliminated. All the relevant facts must be on the table. It may sometimes be necessary to arrange hearings with experts to enable all participants to form a competent opinion.

Exchanging standpoints and views also plays an important role. This serves to explore the topics and to sound out the arguments and interests of the participants. In such situations, all participants have to be given the same opportunities to present their standpoints, the interests behind these standpoints having to be identified, and endeavours made to discover common ground.

The cardinal concern of such procedures is to arrive at a negotiated solution. A number of approaches are possible here, from a round table right through to calling in a neutral third party to assist in the discussions and negotiations. The neutral third party must be (1) non-partisan, (2) acceptable to all participants, (3) sufficiently acquainted with the subject matter, and (4) skilled in handling conflicts.
Finally, care may in some cases have to be taken to weigh up the confidentiality of the talks against the need to inform the public. This applies especially to conflicts high on the public interest scale.

**Evidence based risk communication**
One has to acknowledge that empirically based knowledge on effective risk communication is sparse. Over the last few years a small number of empirical risk communication evaluation studies have been carried out, for instance about the effectiveness of presentation formats (e.g. Burger et al. 2003; Connelly & Knuth 1998) or the influence of process characteristics (e.g. Santos & Chess 2003; Tinker et al. 2000), and others have addressed the methodological problems of empirically evaluating risk communication (e.g. Rohrmann 1992; Weinstein 1999) as well as its psychological foundations (Bostrom et al. 1994).

However, most advice for risk communicators is still based on anecdotal evidence, which cannot be considered a reliable source of information. Therefore, much more effort is needed to evaluate risk communication strategies properly, so as to establish an evidence-based risk communication policy. To give just on example: Our own experimental research on the impact of participation on mitigating siting conflicts (Wiedemann et al. 2005), revealed that participation has no significant impact on risk perception, trust in safety management, perceived conflict prevention, and on acceptance of a site. However, participation seems to have an impact on perceived transparency of the siting process and on the perceived opportunity to manage an existing conflict productively.

**Outlook**
Risk communication is based on three building blocks, which must be set up in conjunction: The quality of the social relationship, the design of the information and the modelling of the dialogue between the participants. It relies on a positive appraisal of the

competence, fairness and social responsibility of the partners in the communication process. Without such a positive appraisal, risk communication is bound to fail.

The aim of conveying information and knowledge is to close the gap between the actual problem inherent in the risk and the way the risk is viewed. To this end, it is important on the one hand to get across the facts that are material to an understanding of the risk and on the other to answer the questions posed by the public. Good risk information practice requires to disclosing its own expertise, to describe the risk assessment framework, and to give the pros and cons of the risk judgement.

Good risk communication requires a concrete shape to be given to the dialogue between the participants. One-sided information that takes no notice of the concerns of the other side is not a basis for successful communication. It is important to realize that risk communication is not persuasion. The goal should not be to try to use risk communication to influence or persuade the other stakeholders, but to mutually inform in a dialogue. Any communication carries with it the interests of the communicator, which is perfectly normal and legitimate, but if the sole interest for participating in a dialogue is to persuade, the information recipients will – sooner or later – loose interest and trust in the conveyed messages.

Last but not least, risk communication strategies and formats should not only based on good intentions and expert opinions. More evidence based risk communication is needed.

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## Models of Science and Policy: From Expert Demonstration to Participatory Dialogue[1]

Silvio Funtowicz

European Commission – Joint Research Centre (EC-JRC) 21020 Ispra (VA) – Italy[2]

### Introduction

In this presentation I will focus on the role of science in the development and implementation of policy. I shall briefly discuss a number of conceptual *models* describing the relationship and interface between science and policy. These models come with their particular underlying assumptions, strengths and limitations, and no single model can be said to offer the universal solution to the challenges.

I argue – along with a growing literature on these problems (see for instance Wynne 1992, Funtowicz & Ravetz 1993, Nowotny *et al* 2001) – that a re-thinking of the relationship between science and policy (and indeed politics) is called for. In the modern tradition of European Enlightenment, the relationship between science and policy was thought to be simple in theory, even if complicated in practice: Science informs policy by producing objective, valid and reliable knowledge. To develop a policy was thus a matter of becoming informed by science and then, in a second step, to sort out diverse values and preferences. Below, I shall call this the *modern model*.

In theory, the modern model is easy to justify, to the extent that it is often taken for granted. Its justification, however, presupposes a number of assumptions that only rarely are expressed in full. First, it is assumed that the scientific information available really is objective, valid and reliable. When there is considerable scientific uncertainty, such as when the facts are highly uncertain, or when experts are in strong doubt, the modern model is no longer the unique rational design choice for the relationship between science and policy.

The same would apply in the case where there are conflicts of interest, such as when the experts are themselves stakeholders. Second, the modern model assumes not only that uncertainty can be eliminated or controlled, but also that the scientific information can be complete in the sense that it tells the policy-maker everything that is necessary to know in order to decide for the common good: There is only one correct description of the system, and it is to be provided by science. If there are several descriptions of the system, they might be combined and reduced into one all-encompassing scientific description. In other words, the modern model assumes that the system and the problem at hand are *not complex.*

I believe that recognition of irreducible scientific uncertainty and complexity in many policy issues requires a fundamental departure from the modern model, revisiting its definition of knowledge as well as governance. Knowledge is not only produced by science and governance is more than deducing action from facts and preferences.

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[1] This is a summary of the chapter *Models of Science and Policy* by S. Funtowicz & R. Strand in Biosafety First: Holistic Approaches to Risk and Uncertainty in Genetic Engineering and Genetically Modified Organisms; Traavik, T. and Lim, L.C. (eds.); Tapir Academic Press, Trondheim, 2007

[2] The views expressed are those of the author and do not represent necessarily those of the European Commission

**The Evolving Relation between Science and Policy**

What is the role of science in governance? What should be the relationship between science and policy?

First, I should clarify that there are two entirely different types of relationships between science and policy. The one hitherto discussed is that of science as *informing* policy. However, science is also the *object* of policy, in the sense that a number of policy decisions regulate scientific practice. Likewise, it may be seen that the science that informs policy may successfully or unsuccessfully try to eliminate or reduce uncertainty, but at the same time scientific and technological practices are among the main uncertainty *producers*, introducing novel and emergent technologies, organisms and forms of life. It is exactly this potential for innovation that currently enjoys the focus of attention in the research policies of many countries. With no more physical land on the planet to colonise, science (together with the outer space) provides the "endless frontier" to be conquered and capitalised upon (Bush 1945, Rees 2003).

On the other hand, the potential for unexpected surprising and possibly negative collateral effects is becoming increasingly acknowledged. The challenge, however, is that our societies have not developed yet the institutions required to handle the situation. Indeed, it appears that the main responses to production of uncertainty are those of "ethical regulations" in the case of the medical life sciences and "risk assessment/management" in the case of the science-based technologies, while the underlying assumption of the general desirability of accelerating research and innovation rates is left unchallenged.

In what follows, I shall concentrate on the science that informs policy. However, the two distinct types of relationship between science and policy cannot be entirely separated. Sociologically, there may be connections or even overlap between the experts who inform and the scientists whose interests are affected by the policy decisions (De Marchi 2003).

Alvin Weinberg (1972) coined the term "trans-scientific" for "questions which can be asked of science and yet *which cannot be answered by science* [original italics]" (p. 209). Weinberg offered the example of the health risks of low-dose radiation, but he also discussed the general problem of weighing the benefits and risks of new technologies, decades before the debates on cloning, human embryonic stem cells, nanotechnology, and climate change.

What to do about it? The re*solutions* have been captured into five ideal types, or models (Funtowicz 2006). I will present and briefly discuss them with regard to bio-safety.

**The Modern Model**

This model was already presented in the Introduction: Science determines policy by producing objective, valid and reliable knowledge. To develop a policy is accordingly a matter of becoming informed by science and then, in a second step, sorting out values and preferences in order to formulate the correct and rational policy.

The modern model has played a crucial part in the legitimation and consolidation of science, governance and political institutions in modern societies. It also works at a deeper cultural level in the modern state, securing the belief in the Enlightenment,

progress and the superiority of the secular, Western scientific-economic rationality expressed quantitatively.
The problem arises then, when (i) experts disagree, are seen to be stakeholders themselves or simply do not know, (ii) uncertainties cannot be reduced to probabilistic risks and (iii) complexities abound. The following three models can be seen as attempts to fix these anomalies (Kuhn 1962), to adjust and rescue the modern model from the challenges of conflict of interest, uncertainty and ambiguity.

**The Precautionary Model: Rescuing the Modern Model from Technical and Methodological Uncertainty**

In real policy processes, it is easily discovered that the scientific facts are neither fully certain in themselves, nor conclusive for policy. Progress cannot be assumed to be automatic. Attempts at control over social processes, economic systems, and the environment can fail, leading sometimes to pathological situations. During the last decades, the presence of uncertainty has become gradually acknowledged, in particular with regard to environmental issues. Because of the incompleteness in the science, it is proposed an extra element in policy decisions, precaution, which both protects and legitimises decisions otherwise within the modern model. The second model to be presented here, introduces the precautionary principle or approach into the modern model, in particular in the way it is being used in the European context.

Precautionary "principles" and "approaches" have been built into a number of conventions, regulations and laws, notably the Rio Declaration on Environment and Development (1992). The exact description of the precautionary principles and approaches vary. However, the "double negative" formulation of the Rio Declaration is illuminating and typical:

*[...] Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.* (from Principle 15)

In the Communication of the European Commission (COM 2000:1) on the precautionary principle, reference to scientific uncertainty is made, but it is emphasised that the precautionary principle is "particularly relevant to the management of risk" and that

*[the] precautionary principle, which is essentially used by decision-makers in the management of risk, should not be confused with the element of caution that scientists apply in their assessment of scientific data.*

In the same communication, the Commission emphasises how arbitrary claims of precautionary measures cannot be supported by the precautionary principle. The latter is only to be invoked where a scientific evaluation concludes with evidence of risk, and only where precautionary measures are consistent with the principle of proportionality (between costs and benefits).

The normative principle of precaution is accordingly framed and expressed in terms of quantitative science. One may ask about the difference in practice between the precautionary model and the modern model, given that scientific evidence is never

"certain". The answer appears to be that there are situations where the scientific community largely *believes* in the existence of certain harm or risk although the scientific evidence is not yet conclusive according to normal scientific standards. In other words, concrete and specific evidence of harm exists, but the technical and methodological uncertainty is slightly larger than what the standard conventions of scientific journals allow (usually 95% confidence in the case of statistical uncertainty[3], see also Gigerenzer (2004)). Epistemological uncertainty, of the type "we do not know what kind of surprises this technology could lead to", would be rendered unscientific and unsuitable by the precautionary model.

**The Framing Model: Rescuing the Modern Model from Indeterminacy**

A number of framing decisions may affect in a crucial way the outcome of scientific advice, as well as the resulting policy. Framing decisions include choice of types of effects, array of safety measures, species, scope of time and place, expert communities and even scientific disciplines to consult. The virtually endless multitude of alternative framings is related to what Wynne (1992) calls indeterminacy. There are no simple algorithms to resolve all these issues. Hence the framing of the relevant scientific problem to be investigated, even the choice of the scientific discipline to which it belongs becomes a prior policy decision. It can therefore become part of the debate among stakeholders. Different scientific disciplines themselves become competing stakeholders; whoever "owns" the research problem will make the greatest contribution and will enjoy the greatest benefits.

Institutions are well aware of the problem of indeterminacy and of potential disagreement among expert communities. In an attempt to establish guidelines for the use of experts (COM 2002:713), the European Commission states:

*The Commission might be confronted by panoply of conflicting expert opinions, coming variously from within the academic world, from those with practical knowledge, and from those with direct stakes in the policy issue. These opinions may be based on quite different starting assumptions, and quite different objectives. [...] Increasingly, then, the interplay between policy-makers, experts, interested parties and the public at large is a crucial part of policy-making, and attention has to be focused not just on policy outcome but also on the process followed.* (p. 2)

The various attempts at accommodating the modern model to this challenge can be summarised in a *framing model.* The mentioned guidelines primarily foresee an enlightened debate within the administration about how to frame the issue and choose the experts; other developments under the keyword of *governance* also envision participation by citizens and stakeholders in the framing process prior to scientific investigation – so-called upstream engagement.

[3] It should be kept in mind that the 95% is due to convention and a result of history. Ronald A. Fisher, the leading statistician in the development of statistical tests and the concept of significance, wrote: "It is open to the experimenter to be more or less exact in respect of the smallness of the probability he would require before he would be willing to admit that his observations have demonstrated a positive result. [...] It is usual and convenient for experimenters to take 5 per cent as a standard level of significance [...]." (Fisher 1951, p. 13)

However, an incorrect framing of the problem (e.g., due to error, ignorance, poor judgement, and not necessarily wilful) amounts to a misuse of the tool of scientific investigation. But because there is no conclusive scientific basis for the choice of framework, it has to be admitted that, to some extent, the choice is arbitrary (or social), and certainly not a matter of "objective science". Acceptance of the principle of framing entails an acceptance of some degree of arbitrariness of choice (ambiguity), hence of the possible misuse of science in the policy context and, moreover, of the difficulty of deciding whether or not a misuse has occurred. Indeed, framing will itself influence the judgement.

The framing model is interesting for several reasons. It can be seen as an attempt to acknowledge and somewhat redistribute the power balance between experts and lay people: the non-scientific framing exercise that scientists often implicitly (and unselfconsciously) perform, is taken away from them and democratised, at least at a superficial macro level. The framing constraints built in the methodological details of the scientific investigation, as well as the appropriation of knowledge by science, are not addressed. In order to know of and to specify all the crucially important criteria for quality of evidence to avoid any indeterminacy, non-experts would have to be experts and could just as well do the research themselves.

The European Commission guidelines mentioned above (COM 2002:713) resolve the issue of indeterminacy in the framing by calling for a plurality of perspectives:

*The final determinant of quality is pluralism. Wherever possible, a diversity of viewpoints should be assembled. This diversity may result from differences in scientific approach, different types of expertise, different institutional affiliations, or contrasting opinions over the fundamental assumptions underlying the issue*.

*Depending on the issue and the stage in the policy cycle, pluralism also entails taking account of multi-disciplinary and multi-sector expertise, minority and non-conformist views. Other factors may also be important, such as geographical, cultural and gender perspectives.* (p. 9)

**The Demarcation Model: Rescuing the Modern Model from Conflict of Interest**

The last adjustment of the modern model to consider here is the demarcation model. This model resembles the framing model in the acknowledgement of expert disagreement and bias. However, both diagnosis and prescription are different. Where the framing model sees the need to specify better the values to be included in the experts system, the demarcation model is more concerned with supervising the values in action in the process of creating scientific advice:

*The scientific information and advice used in the policy process is created by people working in institutions with their own agendas. Experience shows that this context can affect the contents of what is offered, through the selection and shaping of data and conclusions. Although they are expressed in scientific terms, the information and advice cannot be guaranteed to be objective and neutral. Moreover, science practitioners and their funders have their own interests and values. In this view, science can (and probably will) be abused when used as evidence in the policy process. As a response to this problem, a clear demarcation between the institutions (and individuals) who provide the*

*science, and those where it is used, is advocated as a means of protecting science from the 'political interference' that would threaten its integrity. This demarcation is meant to ensure that political accountability rests with policy makers and is not shifted, inappropriately, to the scientists.* (Funtowicz 2006)

An example of the demarcation model is the desire for a clean division between risk assessment and risk management. Another is the attempt to establish "independent" studies or research groups, and perhaps also the insistence on "sound science".

Concretely, when the situation is highly polarised and conflict is apparent, it is extremely difficult to have a waterproof separation between risk assessment and management. And how do we decide (and who decides) in practice which is an input of fact and which an input of value? Stakeholders may be experts (farmers and fishermen, for instance), and experts may be stakeholders (entrepreneurial science).

**The Model of Extended Participation: Working Deliberatively within Imperfections**

The alternative models described above can be considered as a progression from the initial modern model with its assumption of the perfect effectiveness of science in the policy process. Concerning the precautionary, framing and demarcation models, the imperfections can be seen to form a sequence of increasing severity, admitting incompleteness, misuse and abuse. There is still the desire, in each case, that science is linked to policy directly and without mediation. Respectively, the three models address the challenges of uncertainty and complexity by enabling precaution to modify policy, by including stakeholders in the framing of decision problems, and by protecting scientists from political interference. However, the core activity of the modern model, the experts' *(desire for)* truth speaking to the politicians' *(need for)* power, is left unquestioned and unchanged. In what follows, I will question the legitimacy of this core activity, and sketch the alternative model of policy that arises from that questioning. I call this the *model of extended participation*.

The underlying ideas of the model are those previously developed by Jerry Ravetz and myself (1990, 1993) in our work on uncertainty, quality and post-normal science. When a policy issue is complex, decision stakes are high and facts are uncertain and/or in dispute, scientists may still endeavour to achieve the truth, but the many "truths" of the systems to be decided upon are simply unknown and, in any case, not available at the time-scale of the decision. This does not imply that scientific knowledge is irrelevant; it does mean, though, that truth is never a substantial aspect of the issue.

Whether or not to put emphasis on a given piece of expert advice becomes a matter of assessing and assuring its *quality*. To some extent, and in some cases, one might be justified to simplify the matters by dividing the task of quality assurance into an internal and an external component. The internal component would then correspond to the peer review system of academic science in which fellow scientists examine to what extent the scientific work has been conducted according to the methodological standards of the discipline. The external component would correspond to an assessment of the policy relevance of the advice. In sum, the issue of quality assurance would then have been divided into *facts* and *values* components. However, as discussed above (explaining the shortcomings of the framing and demarcation models), such a simplification would often be unjustified.

Curiosity-driven, economically disinterested research is becoming the exception rather than the rule in ever more research fields. The mere expansion of the research world has led to worries about the quality of its own internal institutions for quality assurance, i.e., the peer review systems. On the other side, the knowledge and the critical capacities of the so-called lay public is becoming recognised as the ideology of scientism is giving way. Furthermore, with the development of Information and Communication Technologies (ICTs), access to technical information is increasingly hard to close.

The logical implication of this state of affairs is to extend the peer review community and let everybody contribute to the quality assurance process: allow the stakeholders to scrutinise methodologies and scientists express their values. Hence, the vision drawn by the model of extended participation is one of democratisation, not just for reasons of democracy, but also with the aim of improving quality assurance. In this model, citizens are envisioned as both critics and creators in the knowledge production process. Their contribution is not to be patronized by using, in a pejorative way, labels such as local, practical, ethical or spiritual knowledge. A plurality of co-ordinated legitimate perspectives (each with their own value-commitments and framings) is accepted. The strength and relevance of scientific evidence is amenable to assessment by citizens.

**Conclusion**

Quality assurance can thus be seen as a core commitment of post-normal science. Defined in terms of uncertainties and decision-stakes, quality assurance encompasses public interest, citizen, and vernacular sciences.

Collegial peer review is, thereby transformed into review by an “extended peer community” (Funtowicz 2001). The emergence of extended peer communities and what is often called “broader approaches to governance” is an urgent task in the evolving and changing relation between science and society.

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## EMF Hazards and Principles of Risk Perception

Lennart Sjöberg
Center for Risk Research, Stockholm School of Economics, Sweden, and
Department of Psychology, Norwegian University of Science and Technology, Trondheim, Norway

**Abstract**

The paper discusses three types of EMF risks: transmission lines, mobile telephones and base stations. Data are analysed from three different, large, samples from the Swedish population. It is found that personal and general risks of the EMF hazard differ in a way typical of lifestyle risks: larger general than personal risks. Mobile phones were seen as equally risky as base stations. The demand for risk mitigation of transmission lines was moderately well accounted for by a regression model where preoccupation with the risk, and general risk, were the most important predictors. Emotions, especially fear and worry, were found to account for a sizable share of the perceived risk of mobile telephones.

### Introduction

EMF hazards in the form of transmission lines and mobile telephones (receivers and base stations) have been in focus of the concerns of many people. Serious health effects have been assumed or asserted to exist but have not been scientifically proven. The situation is similar to that in many other fields, such as nuclear waste of genetically modified food. Many people are worried and suspect that the assurances of experts and scientists should not be trusted, that they are either scientifically unjustified or even that experts are paid by industry to say what the say. Interestingly, precautionary policies seem to heighten risk concerns rather than the opposite, perhaps because people see such policies as proof that there is really a danger (Wiedemann & Schutz, 2005; Wiedemann, Thalmann, Grutsch, & Schutz, 2006); see also the interesting discussion by Sandman[1].

Information may have a backlash effect, increasing worries rather than decreasing them. Some risk communication attempts have been reported in the literature (Macgregor, Slovic, & Morgan, 1994; Wiedemann & Schutz, 1995), but on the whole research is scarce. The WHO brochure on EMF risk communication (WHO, 2002) cites two volumes of WHO (Repacholi & Muc, 1999) and ICNIRP (Matthes, Bernhardt, & Repacholi, 1998) proceedings. In this situation, it is imperative to pursue studies of how people perceive EMF risks. Siegrist et al. reported some recent work on theses issues (Siegrist, Earle, Gutscher, & Keller, 2005). They found that mobile telephone risks (both base stations and receivers) were rated as lower than risks of high voltage transmission lines.

There are general principles of risk perception, but each new type of hazard requires its own analysis. In this paper, three areas of risk perception are covered, and data are presented covering how EMF risks are perceived: general and personal risk, demand for risk mitigation or policy attitudes, and emotions and risk perception.

[1] http://www.psandman.com/articles/vodafone.pdf, accessed May 21, 2007.

These results are potentially important as a basis for risk communication, for several reasons:

(1). The sheer level of perceived risk is a factor to take into account. Elevated levels of perceived risk may lead to various social, political and economic disturbances. It must be noted, however, that both personal and general perceived risk are important because they tend to have different policy implications (Sjöberg, 2003).

(2). Demand for risk mitigation is partly driven by perceived risk, but by no means identical to it. The correlation between risk and demand for risk mitigation is moderate or small, and other factors enter the picture, such as risk concern, severity of consequences and emotions (Sjöberg, 2000a).

(3). It is generally held that emotions, or "feelings", play an important role in risk perception (Loewenstein, Weber, Hsee, & Welch, 2001). While the data are often irrelevant to this thesis (Sjöberg, 2006b), it is important to look into the matter with more directly relevant types of evidence.
Summing up, the purpose of the present paper is to investigate the level of perceived EMF risks, the factors in demand for risk mitigation, and the role of emotions.

**Data sources**

These data sets contain information about the perceived risks of power lines, mobile telephones and base stations. The coverage is somewhat uneven, e.g. emotional reactions were only studied with regard to mobile telephones.

The analyses reported here come from 3 different survey data sets.

1. Survey data from representative samples of the Swedish population, as well as candidate communities (Östhammar and Oskarshamn) in the search for a site for a final repository for spent nuclear fuel (Sjöberg, 2006a) and a control community (Finspång). About 500 respondents participated in each sample, with a response rate of about 50 percent. See Sjöberg (Sjöberg, 2006a).
2. Data from a representative sample of the population concerning policy attitudes and salience/interest of the hazards, N=747. The response rate was 54.1 percent. For further details, see Sjöberg et al. (Sjöberg et al., 2000).
3. A study focused on gene technology, covering many hazards for comparative purposes (Sjöberg, 2004). A sample from the general population, N=469, was studied; response rate 47.8 percent.

In sum, data came from three large samples from the national population of Sweden. As can be seen the response rates were around 50 percent, which is probably sufficient to draw conclusions about the population. The only clear bias among the respondents, when it comes to demographics, was that of level of education (too high). This facto was not considered to be serious since level of educations usually correlates weakly with perceived risk, see the results section of the present paper for an example.

**Variables**

Risk perception was studied by means of rating scales with 8 categories, from 0=no risk at all to 7=A vary large risk. "Don't know" answers were treated as missing data. A number of related ratings scales used by people in Sample 2 used similar 8-category scales.

Emotional reactions were measured by the following by the following instruction:

*"Make a fast and spontaneous assessment of your feeling about a nuclear waste repository in your municipality".*

A number of emotional reactions were assessed. Note that most of these terms are negative, in accordance with emotion theory (Izard, 1977). The emotions investigated were:

Anger
Contempt
Fear
Interest[2]
Sorrow
Satisfaction[3]
Guilt
Shame
Worry
Pessimism
Optimism

The emotion scales were reverse scored, i.e. higher values implied a weaker emotional reaction. In the second sample, questions were posed about interest and policy attitude with regard to 19 hazards. The respondents were asked to rate "How interesting do you think the following risks are - how much do you for example want to read about them, discuss them or think about them?" They were also asked to respond to the question "How important do you think it is that the Swedish state or municipalities (local and regional) acts to diminish the following risks?" The ratings were done on 8-step category scales in both cases.

**General and personal risk**

Weinstein discovered the phenomenon of unrealistic optimism (Weinstein, 1982). People tend to believe that others are at greater risk then themselves. In our studies, we have routinely asked people to judge both general risk, i.e. the risk to others, and personal risk, i.e. risk to themselves. These ratings typically differ as to level. Personal risks are typically judged as smaller than general risks. However, the difference varies in size across hazards. Lifestyle risks (smoking, drinking alcohol, having unsafe sex etc) are judged with a greater difference between personal and general risk than environmental or technology risks, such as nuclear power risks (Sjöberg, 2003). The former risks tend to be those against which people believe they can protect themselves (Harris & Middleton, 1994). Apparently, they do not believe that others can or want to protect themselves to the same extent.

[2] Used to measure the basic hedonic mood and emotion dimension (Sjöberg, Svensson, & Persson, 1979).
[3] However, see the recent results by Rundmo and Moen (Rundmo & Moen, 2006), where it is found that worry accounts for a sizable share of demand for risk mitigation.

Figs. 1 and 2 give the distributions of risk ratings for transmission lines and mobile telephones and for personal and general risk. For base stations, the result was similar to that of mobile telephones. Fig. 3 gives response distributions for mobile telephones and base stations, general risk. The result was similar when the comparison was made with regard to personal risk.

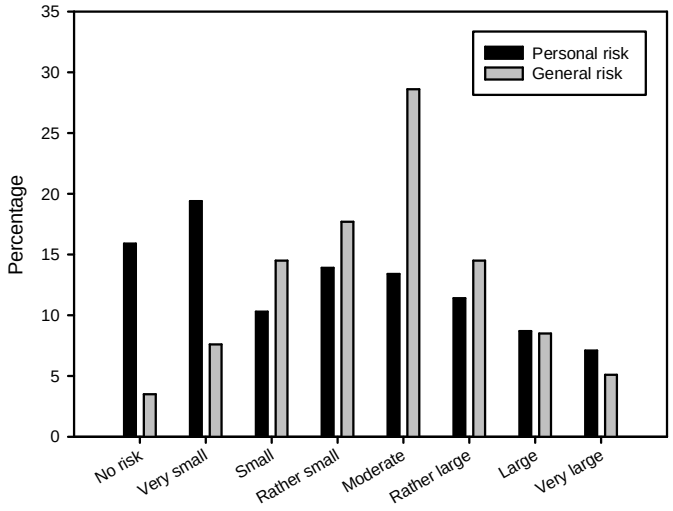


Figure 1. Distributions of risk ratings, transmission lines

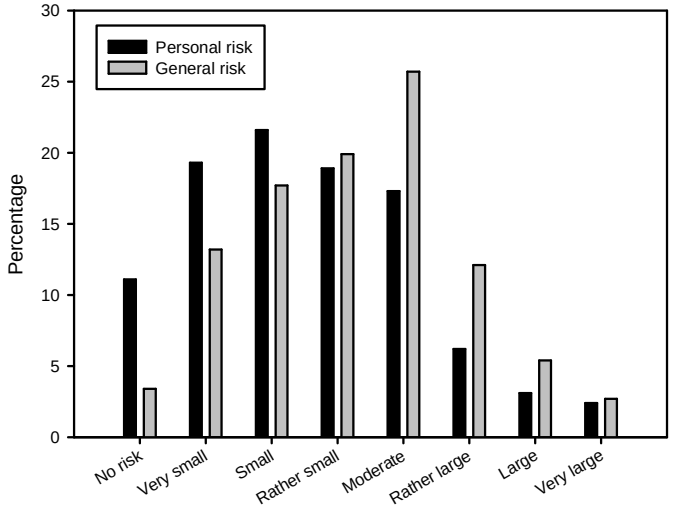


Figure 2. Distribution of risk ratings, mobile telephones

The differences between personal and general risk are typical for “lifestyle” risks for all three EMF hazards. In other words, it is probable that people believe they can protect themselves from the hazards. The data are also illustrated in Fig. 4.

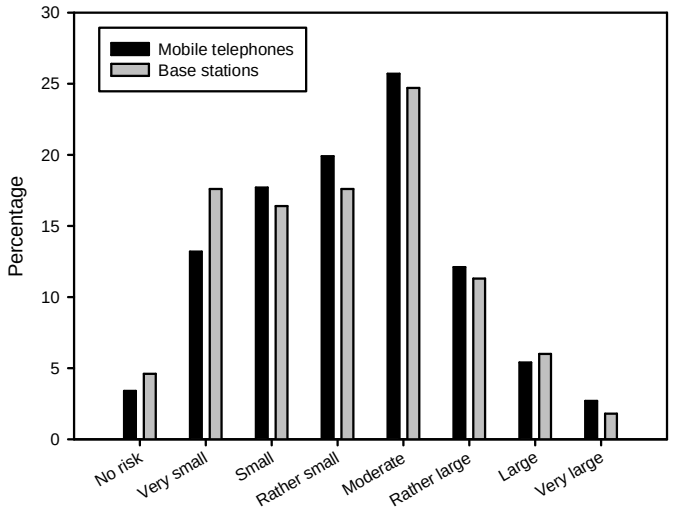


Figure 3. Distributions of ratings of general risk, mobile telephones and base stations

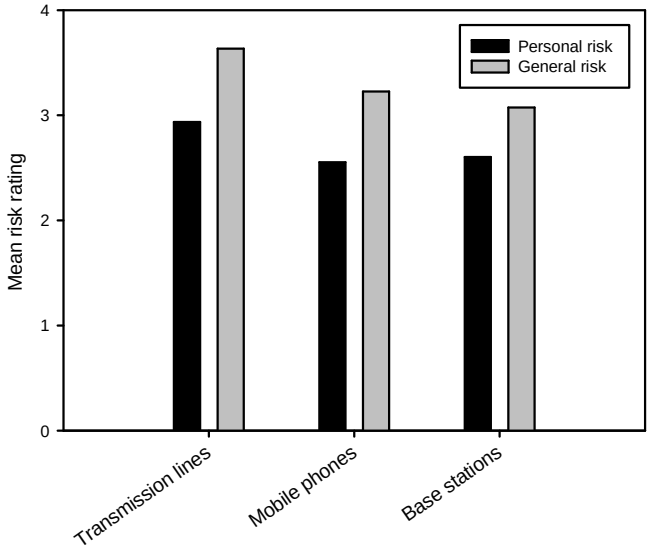


Figure 4. Mean risk ratings for 3 EMF hazards, personal and general risk

The risks were rated at the level rather small – moderate. When it comes to the over-all level of perceived EMF risks, comparison data was also available for a set of 46 hazards. In terms of personal risk, transmission lines had the 17$^{th}$ largest mean value, mobile telephones the 23$^{rd}$, and base stations the 24$^{th}$. The corresponding ranks for general risk were similar: 17$^{th}$, 27$^{th}$ and 29$^{th}$. Hence, only the transmission line risk stood out as

relatively pronounced. The rated EMF risks were correlated with gender, age, and level of education. See Table 1.

Table 1. Correlations between demographics and perceived risks.

| Risk | Gender (male=1, female=2) | Age | Level of education |
|---|---|---|---|
| Transmission lines, personal risk | .127(**) | -.042 | -.035 |
| Mobile phones, personal risk | .059 | -.289(**) | .083 |
| Base stations, personal risk | .106(*) | -.190(**) | .064 |
| Transmission. lines, general risk | .214(**) | .027 | -.112(*) |
| Mobile phones, general risk | .198(**) | -.165(**) | .077 |
| Base stations, general risk | .198(**) | -.131(**) | -.002 |

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The gender differences are in line with many other studies of risk perception and gender: women rate risks as larger than men do. It can also be noted that the gender difference was largest for general risks, also a finding in line with other data (Davidson & Freudenburg, 1996; Sjöberg, 2000b). Young people tended to rate the EMF hazards as larger than older people did. Level of education was only weakly related to level of perceived risk.

**Demand for risk mitigation**

A regression model for demand for risk mitigation of the transmission line hazard is presented in Table 2. The model accounted for 17.5 percent of the variance, which is a high value since it is usually quite hard to account for demand for risk mitigation[4].

Table 2. Results of regression analysis of demand for mitigation of the transmission line risk. N=746.

| | Standardized regression coefficient | t-value | Significance |
|---|---|---|---|
| (Constant) | | 14.602 | .000 |
| Personal risk | .036 | .886 | .376 |
| General risk | .153 | 3.784 | .000 |
| Protection possibility | -.084 | -2.412 | .016 |
| Social trust | -.014 | -.407 | .684 |
| Personal knowledge | -.016 | -.444 | .657 |
| Authorities' knowledge | .094 | 2.739 | .006 |
| Interest, pre-occupation with hazard | .305 | 7.992 | .000 |

It is seen that the most important predictor is interest in and preoccupation with the risk. This is in line with the result of analysing many other hazards (Sjöberg, 1999, July), where it was found that interest was the most important factor in almost all cases. This finding resembles the results of Rundmo and Moen who found that worry was an important factor in demand for risk mitigation (Rundmo & Moen, 2006). The second interesting finding is that general risk played a more important role than personal risk. This finding is in line with previous results where it was found that lifestyle risks were most clearly related to general risk, not so much to personal risk (Sjöberg, 2003). EMF risks are not typical lifestyle risks, but their psychological dynamics, with a large difference between personal and general risks, seems to be similar to that of lifestyle risks.

**Emotions**

A regression analysis of the mobile telephone risk (personal and general combined) gave the results of Table 3. The fit of the model was 26.2 percent. This value is high in the light of the fact that only emotional reactions were entered as explanatory constructs.

Table 3. Results from regression analysis of mobile telephone risk, N=507.

| Emotion | Standardized regression coefficient | t-value | Significance |
|---|---|---|---|
| (Constant) | | 12.193 | .000 |
| Anger | -.074 | -1.291 | .197 |
| Contempt | -.002 | -.027 | .978 |
| Fear | -.299 | -5.032 | .000 |
| Interest | .068 | 1.451 | .147 |
| Sadness | .019 | .351 | .725 |
| Satisfaction | -.046 | -.879 | .380 |
| Guilt | .022 | .363 | .717 |
| Shame | -.049 | -.799 | .425 |
| Worry | -.214 | -3.505 | .000 |
| Pessimism | .054 | .914 | .361 |
| Optimism | .121 | 2.407 | .016 |

Fear, worry and optimism were the most important emotional factors, according to the regression analysis.

**Discussion**

The results were as follows:

- EMF hazards had the typical characteristics of lifestyle risks: larger general than personal risks, and general risk more important for policy demands than personal risk.
- Mobile telephones and base stations were rated as less risky than transmission lines. Mobile phones and base stations were rated as equally risky.
- Interest/pre-occupation with the risk was an important factor in accounting for policy demand. The latter factor was moderately well accounted for in the regression model.
- Emotions especially fear and worry, were important explanatory factors in perceived mobile telephone risk.
- Women and young people tended to rate EMF risks, especially general EMF risks, as large. Level of education was unrelated to perceived EMF risk.

In future work, it would be interesting to relate perceived EMF risks to a measure of precautionary attitudes (Sjöberg, 2006a), and to investigate the role of emotions in a context of other explanatory factors. Trust is also a relevant topic, and the notion of epistemic trust, i.e. trust in Science as distinguished from social trust, is likely to be an important factor in the case of EMF risks, just as it has been found to be in studies of nuclear waste risks (Sjöberg & Wester-Herber, in press) and gene technology (Sjöberg, 2004).

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# How Does the Public Think About Risk? Issues in Risk Perception and Risk Communication

Neil D. Weinstein
Department of Family and Community Medicine,
College of Medicine, University of Arizona, U.S.A.

Anyone who becomes involved in risk communication soon learns that this is a complex topic. One aspect of risk communication is obviously the transmission of information about hazards. Delivering such information may seem straightforward, but its success is influenced by many different variables, including the education, intelligence, numeracy, cognitive biases, and attention of the audience (National Cancer Institute, 2007). Success in information delivery is also influenced by the complexity of the information that needs to be transmitted and by the ways in which the information is presented.

But this is only part of risk communication. Communication is also a social and political process. Its success is, consequently, also influenced by issues of power, trust, transparency, equity, consultation, past history, and the egos of the parties involved (Pigeon, Kasperson, & Slovic, 2003). In many risk controversies, the social and political obstacles to open and respectful communication are so great that information content and presentation are largely irrelevant. Without in any way minimizing the importance of social and political factors, the remainder of this chapter will examine some issues that arise in the transmission and comprehension of risk information.

## What Is Risk?

Risk communication demands an appreciation for how the public thinks about risk. As a first step toward this goal, it is essential to realize that the word "risk" itself has multiple meanings. In the sentence "What are the risks of smoking?", "risk" refers to outcomes, to possible negative consequences. In contrast, when one asks, "What is the risk that a smoker will develop heart disease?", "risk" refers to the probability of an outcome. Finally, if someone asks, "Is smoking really risky?", the word "risky" refers to potential serious outcomes that have a substantial probability of occurrence. Since "risk" is used by experts and laypeople in these various, contradictory ways, communicators need to be very careful in their language, making sure whenever they use the term "risk," that its meaning is clear by context or by explaining precisely what they have in mind.

## What Is Risk Perception?

The associated term, "risk perceptions," is equally broad. It includes: 1) beliefs about potential negative outcomes from an event or activity, 2) beliefs about the nature of these consequences, and 3) beliefs about the probability of these negative consequences. Finally, "risk perceptions," also includes 4) a person's beliefs about his or her personal risk and about the factors that modify his or her risk (Weinstein, 1999). This last topic must be included because people typically differentiate between themselves and others. In particular, individuals frequently acknowledge risks to others, but claim that their own risk is less (Weinstein, 1987). For this reason, warnings have a greater chance of success if they are personalized than if they refer to people in general or to an unspecified target audience.

Under topic 1, the nature of negative outcomes, would fall beliefs about whether the outcome is probable (which is important enough to be listed separately), chronic, painful, disabling, disfiguring, delayed, progressive, fatal, acute, imminent, infectious, treatable, localized, visible, variable, random, symptomatic, embarrassing, and other characteristics. Some research, much of it referred to as using a "psychometric paradigm," has been carried out to determine which dimensions of negative outcomes—other than probability--impact risk judgments. This work has emphasized risky technologies and activities, rather than illnesses or injuries, and it tends to have a policy orientation rather than seeking to understand individual actions. Because it is well described elsewhere (Lichtenstein et al., 1978; Slovic, 1987, 2000), the present chapter will focus on probability, both about how to elicit perceptions of probability and how to communicate probability information.

**Laypeople's Probability Language**

Scientists rely on numerical expressions, such as frequencies, odds, percentages, decimals, and odds ratios, to communicate their findings about risk probabilities. It is problematic, however, to use this same language to communicate with the public. Almost never—except for weather forecasts—do people (laypeople or experts!) use *numerical* information about risk probabilities to make everyday life decisions. Even familiarity with a hazard does not lead to numerical thinking. When asked, laypeople will answer all kinds of numerical risk questions, but it is a serious mistake to assume that they understand numerical response scales, that they normally think in terms of these response units, or that the answers they give to such questions bear any relationship to how they would behave in a real situation. Numerical estimates of probability are often wrong, even dramatically wrong, but people may still understand enough to make reasonable decisions about a risk. Furthermore, getting the numbers right does not mean that someone understands the risk sufficiently to make informed decisions.

The language that laypeople use to talk about risk probabilities is not very precise. They use descriptors like "tiny," "big," "negligible," "small," "high," "very low," and "not much." A communicator might be tempted to select an ordered set of these terms and use them in risk messages in an attempt to convey quantitative probability information. But it would be a major mistake to assume that these terms are interpreted consistently from one person to the next. Figure 1, for example, shows the verbal labels people choose to represent different numbers (22%, 42%, 58%, and 78%).

Each study participant was given one of these percentages and was then asked which term ("extremely small," "very small," "small," "moderate," "large," "very large," or "extremely large") best represented that number. The figure (data from Waters, Weinstein, Colditz, & Emmons, 2007a) shows that the correspondence between numbers and labels was very loose, with people choosing widely different labels to represent the same number. Studies (Beyth-Marom, 1982; Bryant, Norman, 1980; Budescu, Wallsten, 1985) that have taken the opposite approach—i.e., giving people verbal terms and asking them to assign numerical equivalents—all come to the same conclusion. Verbal risk labels are not satisfactory for communicating quantitative risk information.

Eliciting probabilities, however, is not the same as communicating probabilities. Sometimes one needs to find out how large people think the probabilities are. In this situation, a 7-point verbal scale—such as, "almost no chance," "very unlikely," "unlikely,"

"moderate chance," "likely," "very likely," "almost certain")—has proved best in several studies (Diefenbach, Weinstein, & O'Reilly, 1993; Weinstein, McCaul, Gibbons, & Gerard, 2007). Compared to other scales with different numbers of steps or with numbers rather than verbal labels, the 7-point verbal scale tends to have the greatest test-retest reliability of risk judgments, the largest correlation with known risk factors or with subsequent behaviour, and the highest ratings of satisfaction by scale users. One cannot use such a scale to determine whether a risk perception is accurate (i.e., whether it is larger or smaller than the actual risk (a numerical statistic), but it can be used to predict behaviour across individuals and to assess the effects of interventions on risk perceptions.

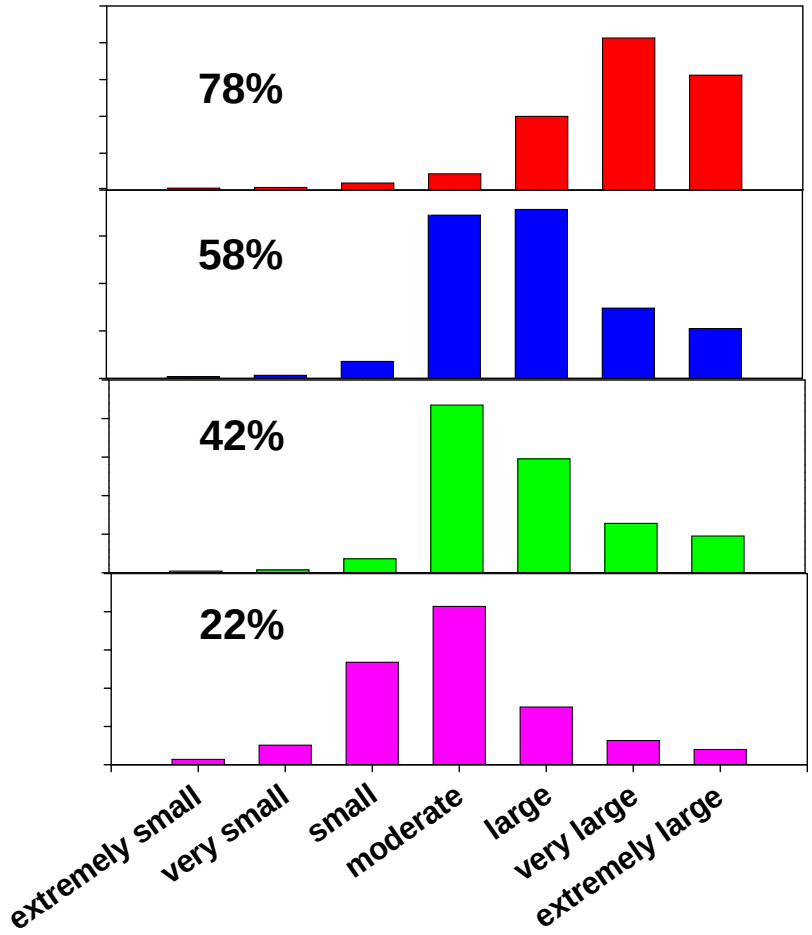



Figure 1. Perceived verbal equivalents of different risk percentages

**Alternative Formats for Conveying Risk Numbers**

Since we cannot communicate quantities accurately with verbal risk terms, what is the best format for presenting the risk numbers? Given the many ways in which the same number can be expressed—e.g., 12.5%, 1 in 8, 12.5 in 100, 125 in 1,000, .125 probability, and 1 to 7 odds all express exactly the same quantity--is one way better understood than others? This question was investigated by examining the ability of study participants to

carry out simple operations involving probabilities, using operations of the sort they might encounter when speaking with a physician (Cuite &Weinstein, 2005). For example, if the physician mentioned two probabilities, would the patient be able to understand which one was larger? The tasks used to evaluate the different formats are shown in Table 1.

Table 1. Operations used to evaluate numerical probability formats

| **Operation** | **Type of Question** |
|---|---|
| Comparison | Which of two risks is bigger? |
| Division | What is the new value when action cuts a risk in half? |
| Multiplication | What is the new value when a risk is tripled? |
| Addition | What is the sum of two (mutually exclusive) risks? |
| Trade off | When an action cuts one risk in half but doubles another, is the overall probability of harm changed? |
| Sequence | If an action produces a side effect with a probability Y, and if the proportion Z of these side effects is serious, what is the probability of a serious side effect? |

Note: Specific risk probabilities were used when the questions were posed to study participants.

The risk formats tested were "1 in n" (e.g., 1 in 8), percent (e.g., 12.5%), and frequency (e.g., N over a denominator that is a power of 10, such as 125 in 1,000). The participants in this experiment were over 12,000 visitors to a cancer risk website.

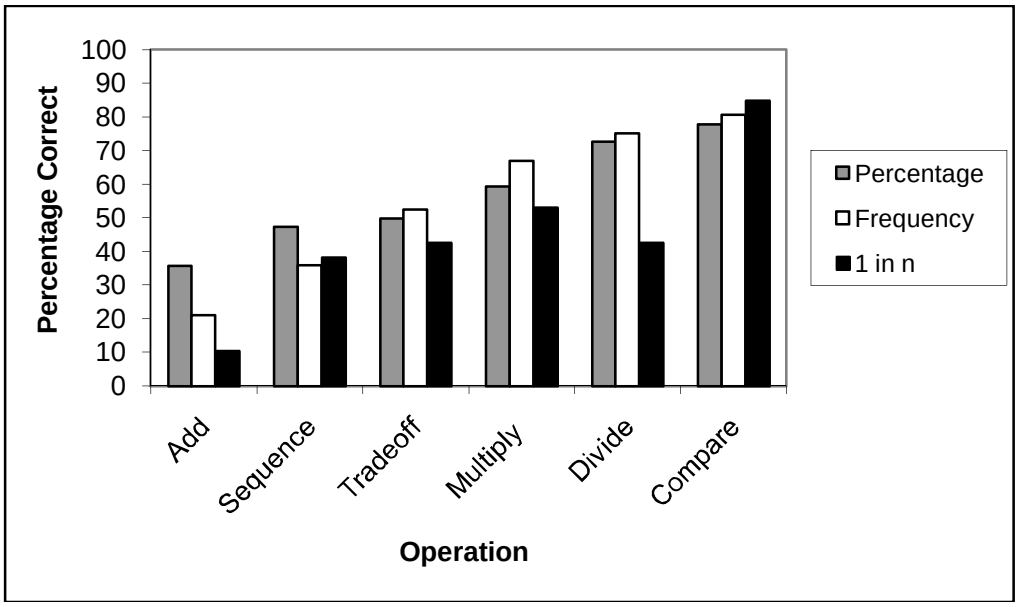



Figure 2. Percentage correct on each operation by format

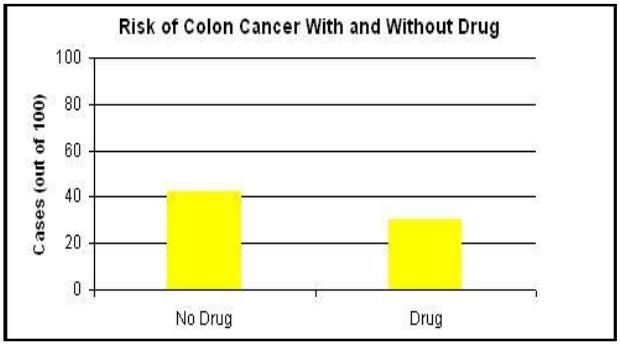
The results are shown in Figure 2. Except for simply comparing two probabilities, task error rates were mostly over 40%, and for several tasks error rates were considerably higher. The "1 in n" format generally performed worst, with accuracy rates for the other

two formats being roughly the same. Error rates decreased with the educational level of participants, but the relative performance of the three formats remained the same within each level of education. Clearly, with none of these three formats does the error rate in carrying out basic probability operations fall to acceptable levels.

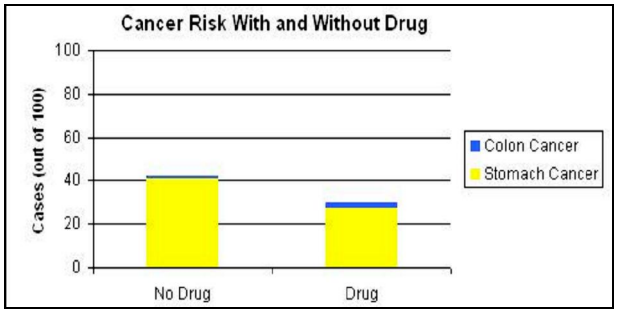
**Understanding and Evaluating Risk Probability Information**

Other studies have provided further evidence of the barriers to effective risk communication. In one (Waters, Weinstein, Colditz, & Emmons, 2007a), participants were given instructions, such as the following. "Imagine your doctor says that your risk of getting colon cancer in the future is 22 percent. A new drug would decrease your risk of developing colon cancer to 10 percent. You'd have to take the drug daily for the rest of your life. Would taking the drug increase, decrease, or not change your overall risk of getting cancer?" A surprising 28 percent of participants with a 4-year college degree did not recognize that this drug produced a decrease in cancer risk. The corresponding figures were 31 percent and 45 percent for those with a 2-year college degree and with a high school education or less, respectively. This data demonstrate that when risk probability "problems" are presented in a narrative format, such as this example, many people are unable to comprehend even very simple risk information.

Another problem in risk communication is that people may apply subjective and inappropriate weightings to risk numbers. For example, they show over sensitivity to treatment side effects (Waters, Weinstein, Colditz, & Emmons, 2007a). Experiment participants in the control condition were asked to consider a hypothetical drug that could reduce their risk of colon cancer from 22% to 10%. Participants in the side effect condition were told that the drug could reduce their risk of colon cancer from 21% to 7%, but it would increase their risk of stomach cancer from 1% to 3%. Assuming no interactions in the side effect condition, both groups were offered a risk reduction of about 12%. When no side effect was mentioned, 56% of participants said they definitely or probably would take the drug, but with a side effect, this number fell to 34% despite the same net decrease in risk. (The results were unchanged when "colon cancer" and "stomach cancer" were switched in these problems.) Thus, laypeople's decisions appear to be distorted by their aversion to side effects. The same preferences were found when frequencies (e.g., 22 in 100) replaced percentages in the problems.




No side effect

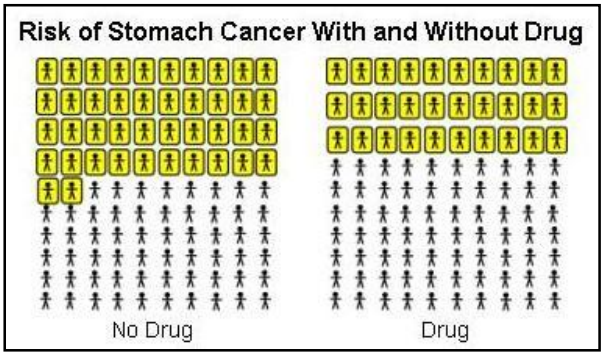



Colon cancer side effect

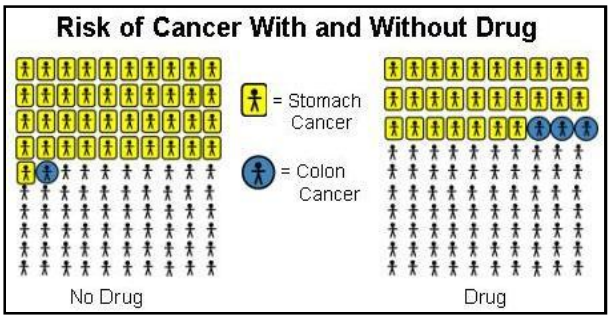
Figure 3. Colon Cancer. Bar graphs without and with side effect

A follow-up study (Waters, Weinstein, Colditz, & Emmons, 2007b) investigated whether visual representations of risk, when added to the risk numbers themselves, could reduce this side effect aversion. Two approaches were tested: bar graphs and arrays of small human stick figures (see Figures 3 and 4). With both types of graphics one could determine the effect of the new drug without performing any mental calculations. In effect, the two types of visual aids reduced the calculation problem to a matter of visual perception. But they were not equally easy to use. In fact, the bar graph had little effect. It did not reduce side effect aversion (willingness to take the drug was 35% in the side effect condition), but it did somewhat decrease willingness in the no-side-effect condition (to 50%), which is not necessarily a desirable outcome.

Much more desirable were the results from the condition in which people were given pictorial arrays to supplement the risk numbers. In this condition, side effect aversion was practically eliminated: willingness was 52% in the no-side-effect condition and 50% in the side effect condition, with these two numbers not being significantly different from one another.




No side effect




Colon cancer side effect

Figure 4. Colon Cancer. Stick figure arrays without and with side effect

Such results are very encouraging. Although our studies show that choosing the optimum numerical format for presenting risk probabilities has only limited benefits, adding carefully designed visual aids may be able to help people make appropriate risk decisions and may even eliminate pre-existing biases.

**Accepting Personal Risk Estimates**

A different type of barrier to risk communication is the difficulty people have in accepting individualized risk information if it differs from their prior expectations. This is true even if they understand the information and believe that the communicator is trustworthy. This finding is not simply a matter of denial. Many studies report that people continue to overestimate their risk of negative health outcomes even after receiving authoritative, individualized estimates indicating that their actual risk is *lower* than they believed (e.g., Dillard, McCaul, Kelso, & Klein, in press; Gurmankin, Baron, & Armstrong, in press; Lipkus, Klein, & Rimer, 2001; Lipkus, Biradavolu, Fenn, et al., 2001). Lerman et al. (1995), for instance, presented women with their calculated breast cancer risk estimates and briefly described what factors were used in the calculations. Nevertheless, following this risk communication, 82% of subjects' risk perceptions remained at least 10 percentage points higher than the number they were given.

Our own studies of colon cancer risk perceptions (Weinstein, Atwood, Puleo, Fletcher, Colditz, & Emmons, 2004) produced similar results. At baseline, approximately 90% of study participants overestimated their risk. They then answered a series of lifestyle and health history questions that were used to calculate their actual risk. After receiving this number, nearly 90% accurately recalled what they had been told. Nevertheless, when asked what they really believed, nearly half still overestimated their risk.

Table 2. Some Possible Reasons for Resistance to Non-controversial Risk Information

- The risk is lower than expected from the amount of public attention it gets and/or from number of victims known.
  "I know too many people with breast cancer for your numbers to be right."
- Laypeople's risk models may not agree with professionals'.
  "I know stress causes cancer, but it wasn't in your questionnaire, so your numbers must be wrong."
- Risk judgments reflect worry and concern, not numerical statistics.
  "I don't really mean 30%. I just mean that it's a major risk."
- Risk perceptions motivate action and keep us from lowering our guard.
  "If I believed you and didn't get screened, I would probably get cancer."
  "If I decided to ignore the risk and than got sick, I would be devastated."
- Poorly calibrated risk numbers. Most serious risks are smaller, numerically, than people think.
  "Aren't cancer risks higher than what you say?"

**Models of Risk Communication Audiences**

We do not yet understand why people reject even comforting risk information. Some of the many possible explanations are shown in Table 2. Once we know the sources of resistance, this information can help direct us toward communication strategies that are more convincing. In the meantime, we must recognize that even with expert information sources, easily comprehended messages, and situations devoid of controversy, risk messages may not be believed.

At least three different models are implicit in discussions of the responses of the public to risk messages. One model, views people as imperfect information processors, trying to assimilate and process information, but frequently failing to get it right. This model explains communication problems in terms of the cognitive limitations of the audience and tries to improve communication by simplifying messages and by improving the formatting of information. A second model views people as irrational actors driven by emotion and biases. They fail to accept communications because their biases and emotions prevent them from viewing the information objectively. Such a perspective can lead to paternalism, to the position that the public should be excluded from policy-making and that decisions should be made for them.

A third model views people as sophisticated skeptics, rejecting or questioning communications from authority figures with good reason. For example, plenty of evidence exists suggesting that a general distrust of government and industry assertions is not an

irrational bias, but a realistic expectation based on past government and industry attempts to cover up problems. This last model suggests that communicators need to pay close attention to the views and responses of the audience, which sometimes may have a more complete and sophisticated view of the risk issue than the experts themselves.

In my own experience and research, I have seen evidence of all three models. People do have cognitive limitations, and they sometimes have biases that prevent them from evaluating information objectively. But they can also show an impressive sophistication and an ability to incorporate many factors into their decisions. Anyone who accepts only one perspective is operating on an oversimplified model of his or her audience and is sure to be a poor risk communicator.

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## Layperson's Perceptions of the Characterisation of Uncertainties[1]

Andrea T. Thalmann, T-Mobile Germany

### 1. Introduction

Considering the assessment and communication of the risks of new technologies, the problem of uncertainty, or of incomplete scientific knowledge, respectively, is one of the key challenges. Risk assessment pertains to the general question, whether new technologies bring about harm for exposed persons, and how to assess these technologies in face of missing data or lack of theoretical understanding of the relevant cause-effect-relationship, etc. Such kind of uncertainty is therefore an inevitable component to be considered in any risk assessment and may refer to different moments in the risk assessment process: from the hazard identification, hazard characterization to the exposure assessment and risk characterization (see definition of risk assessment process NRC, 1983). In all these steps of risk assessment, the epistemic status of the existing knowledge ranges from almost certain to vague assumptions (for the role of evidence in risk characterization see also Wiedemann and Schütz, 2008).

The primary task for the risk characterization is therefore to clarify, how certain (or uncertain) the existing knowledge in the different steps of risk assessment is. And this "power of evidence" has to be communicated properly to non-experts, especially as decision makers, but also to the public. A clear and transparent description of the existing evidence supporting or mitigating a hazard – such as adverse health effects, is needed.

The demand for such a revised characterization is obvious and leads to the questions: how can we characterize and communicate the degree of evidence, when it is below the threshold of scientific proof, and how to address the existing uncertainty in any given risk assessment process? Further, how will layperson perceive of this evidence characterization and interpret the existing evidence respectively? And, does this communication help to enhance the understanding of unclear risks such as HF EMF?

This paper will discuss laypersons' understanding of different numerical and verbal uncertainty descriptions, with a special emphasis on new results regarding laypersons' understanding of different standardized sets of evidence labels, which are used to characterize the unclear risk of HF EMF.

### 2. Laypersons' understanding of different uncertainty descriptions

The communication of uncertainty implies several challenges with regard to the question of how to present and how to describe uncertainty in order to enhance non-experts' knowledge of risk. The research on *uncertainty characterization* discloses multiple pitfalls and biases in communication that are prone to appear when interpreting and referring to numerical or verbal uncertainty descriptions.

[1] The views expressed are entirely those of the author and may not in any circumstances be regarded as stating an official position of T-Mobile Germany GmbH.

### 2.1. How do laypersons understand numerical uncertainty descriptions?

The host of scientific literature states convincingly the substantial impact of the mode of presentation of uncertainty with regard to its comprehensibility. Certain numerical uncertainty description units tend to be misinterpreted more easily by laypersons than others. For example, percentages are often misunderstood. A good example is the meaning of "40%": In a study by Gigerenzer (2002), 1000 people were asked about the meaning of 40%. A standardized multiple-choice questionnaire was used. The given answers include the following three possibilities to choose from: (a) one fourth, (b) 4 in 10, (c) each fortieth. Around one third of the participants didn't understand the 40% correctly. The comprehensibility of uncertainty description depends on the used risk unit (e.g. probability unit, frequency unit, relative risk) and plays a crucial role for assessing risks and the perception of risk (Gigerenzer, 2002; Slovic et al., 2000).

Uncertainty descriptions by *probability units* lead to more biased interpretation, compared to the choice of natural frequency units. One explanation is that natural frequencies might correspond more to people's daily way of thinking. Laypersons' difficulties with probabilistic reasoning are known under "innumeracy": the inability to make sense of numbers. On the cognitive level, it is easier to understand, if one in 10,000 subjects, who had taken a medicament, develops side effects, compared to an equal description in the form of percentages: "the subject develops side effects with probability of 0.0001". Gigerenzer and his colleges (2002) conducted several experimental studies with regard to this phenomenon. The findings stressed that the comprehensibility of the uncertainty is improved by presenting it in the form of natural frequencies.

Also *very small probabilities,* such as p = 0.0001, tend to produce misinterpretations in communication. The Prospect Theory points at this problem: Very small probabilities are overestimated and very high probabilities are underestimated (Lichtenstein et al., 1978; see also the Prospect Theory by Kahnemann and Tversky (1979). Very small probabilities require high cognitive skills for adequate processing. This is one reason why people have difficulties to weigh small probabilities with potential consequences correctly (Magat et al., 1987; Reyna, 1991; Reyna & Brainerd, 1991; Hattis, 1989).

Another often-used uncertainty unit is the *relative risk (RR)*. The relative risk is defined as the probability of the occurrence of an adverse effect in subjects who have been exposed to a risk factor, compared to others without such an exposition. The RR presents the size for a relative effect of a certain exposition and indicates the increased or decreased frequency of a certain disease of exposed subjects, compared to unexposed subjects. Relative risk units let the probability of a consequence appear bigger, compared to another risk description unit in the form of the incidence rate[2]. This phenomenon has an impact on risk perception and risk behaviour. Risk reducing behaviour will be even increased by risk information in the form of the RR compared to identical risk information in the form of the incidence rate. This different impact of the RR and of the incidence rate is even more powerful with regard to very small values (Halpern, Blackman & Salzmann 1989; Stone et al., 1994).

[2] Incidence is defined as the frequency of occurrence of a disease within a certain time period disregarding, if the disease still exists at the end of the time period.

## 2.2. How do laypersons understand verbal uncertainty descriptions?

Besides numbers (e.g. RR, percentages) or confidence intervals, the use of verbal phrases is a common way to describe uncertainty in risk assessment.
Phrases, such as “probably no relationship”, “not likely”, “possible” and so forth, are often used by scientists to express a certain state of uncertainty without committing oneself to a strong statement which would not be supported by the scientific data. These so-called verbal hedging phrases (cf. Hyland, 1998) are often used in risk assessment when a hazard has neither been unequivocally proven nor can it be unequivocally rejected. Hedging phrases refer to the experts’ difficulties to take a stance in light of vague and contradictory results. Since there are, however, practically no rules as to how such narratives are to be implemented, it remains in the subjective judgment of every individual.

Furthermore, vast room for interpretation exists regarding the meaning of these phrases. What, e.g. "rather unlikely" means in contrast to "relationship cannot be excluded" can be interpreted quite differently. Unfortunately, no systematic empirical study exists that investigates the impact of these phrases on risk perception. Notably, an entire research field deals with the clarity of verbal quantifiers. Several studies have shown the ambiguity and lack of clarity of verbal quantifiers (Beyth-Marom, 1982; Brun & Teigen, 1988; Budescu & Wallsten, 1985; Clark, 1990; Fillenbaum, Wallsten, Cohen & Cox, 1991; Fischer & Jungermann, 2003, Moxey & Sanford, 1993; Teigen & Brun, 1999, 2000, Weber & Hilton, 1990).

Laypersons differ in their understanding of verbal expression using probability- or frequency indicators, such as “probable, “possible” or “often”. The subjective meaning of verbal expression does not necessarily correspond with the experts’ intended statement. Fischer & Jungermann (1996, 2003) demonstrate in an experimental study that the laypersons’ numerical equation of verbal frequency categories (rarely, occasionally, and frequently) doesn’t correspond with the numerical meaning provided by the leaflets for medical drugs. Jablonowski (1994) has investigated the meaning of the verbal probability label “unlikely” and concluded that each subject will associate a different numerical value with a given verbal uncertainty description and interpret the meaning differently: Asking people to equate a numerical value for “unlikely” on a scale from 0.00 to 1.00, the answers ranged from 0.09 to 0.30. Additionally, the interpretations of “unlikely” will be quite similar to the estimation for “somewhat likely” (which range from 0.09 to 0.45).

The context in which verbal uncertainty categories are embedded plays a crucial role for the construction of meaning. (Fischer & Jungermann, 2003; Beyt-Marom, 1982; Brun & Teigen, 1988; Fillenbaum, Wallsten, Cohen & Cox, 1991; Gonzaes & Frenck-Mestre, 1993; Patt & Schrag, 2003) The numerical equivalent of the meaning of verbal expressions of frequencies, such as “rarely”, “sometimes” or “frequent” depends on the context. Contextual characteristics modify the meaning of verbal uncertainty descriptions. The verbal expression “frequent” will acquire different meaning in the two following cases: “going to the movie theatre frequently” and “visiting Asia frequently”.

Other studies indicate the contextual influence of the severity of an event or a prospective consequence. Verbal probability descriptions of severe events are interpreted numerically higher, compared to verbal probability descriptions of less severe events (cf. Weber &

Hilton, 1990). The verbal frequency descriptions of severe side effects of a medical drug are interpreted higher, compared to the same frequency description with regard to slight side effects (Fischer & Jungermann, 2003). Thus, laypersons tend to confound probability interpretation with the quality of a consequence (e.g. the magnitude of harm).

### 2.3. Laypersons' understanding of standardized set of verbal evidence categories to describe uncertainty.

Another approach to describe uncertainty in risk assessment and risk characterization is the use of standardized sets of verbal evidence categories. Examples of such category-systems are: the evaluation scheme for carcinogenicity used by the International Agency for Research on Cancer (IARC 2006), the evidence strength classification adopted by the German Radiation Protection Commission (SSK 2001), or the table systems of the Ecolog-Institut, Germany (Ecolog 2001) and of the Swiss Agency for the Environment, Forests, and Landscape, Switzerland (Röösli & Rapp 2003). A good overview on evidence characterization is given by Wiedemann & Schütz (2008).

For instance, the SSK distinguishes between among three levels of evidence supporting a health effect: The verbal evidence category, "proof", describes the scientific proof when a correlation between an agent and a health effect is shown and independently replicated as well as supported by the scientific state of knowledge. The second verbal evidence category, "suspicion", indicates that a correlation between an agent and a health effect is shown by studies, but a causal relationship is not supported by the overall state of knowledge. A "Hint" indicates that only singular studies exist which show a correlation between an agent and a health effect, but no causal relationship is found, nor is it supported by the scientific over all state of knowledge[3].

A study by Thalmann (2005) has tested such evidence categories with regard to their clarity and comprehensibility. The results of the experimental studies provide significant evidence to support that such verbal evidence descriptions are highly ambiguous and vary from person to person. Asking laypersons to associate different verbal evidence categories to numerical values on a scale form 0% power of evidence to 100% power of evidence, brought up disturbing findings: The laypersons' estimations appear widely spread in each verbal evidence description and overlap with other description of the power of evidence, thereby contradicting themselves. Figure 1 visualizes clearly, the participants' perception of the three evidence categories used by the SSK.

[3] Translation from German: Original definition by the SSK (2001, p. 9): **Wissenschaftlich nachgewiesen** ist ein Zusammenhang zwischen einer Gesundheitsbeeinträchtigung und elektromagnetischen Feldern, wenn wissenschaftliche Studien voneinander unabhängiger Forschungsgruppen diesen Zusammenhang reproduzierbar zeigen und das wissenschaftliche Gesamtbild das Vorliegen eines kausalen Zusammenhangs stützt. Ein **wissenschaftlich begründeter Verdacht** auf einen Zusammenhang zwischen einer Gesundheitsbeeinträchtigung und elektromagnetischen Feldern liegt vor, wenn die Ergebnisse bestätigter wissenschaftlicher Untersuchungen einen Zusammenhang zeigen, aber die Gesamtheit der wissenschaftlichen Untersuchungen das Vorliegen eines kausalen Zusammenhangs nicht ausreichend stützt. Das Ausmaß des wissenschaftlichen Verdachts richtet sich nach der Anzahl und der Konsistenz der vorliegenden wissenschaftlichen Arbeiten. **Wissenschaftliche Hinweise** liegen vor, wenn einzelne Untersuchungen, die auf einen Zusammenhang zwischen einer Gesundheitsbeeinträchtigung und elektromagnetischen Feldern hinweisen, nicht durch voneinander unabhängige Untersuchungen bestätigt sind und durch das wissenschaftliche Gesamtbild nicht gestützt werden.

The participants' numeric estimations of the three verbal evidence categories, "proof – suspicion – hint", show that the evidence categories are perceived differently from person to person. For instance, the subjective estimations of the two evidence categories, hint and suspicion, are understood in full contradiction to the intended experts' sense. The study participants do not distinguish the meaning of these two evidence categories from each other. The numerical estimations of "hint" spread between 20% and 59% power of evidence for half of the participants, while the numerical estimations of "suspicion" extend between 14.5% and 50% power of evidence. Furthermore, contradicting the intention of the information source, (which was developed by experts), laypersons associated the verbal evidence description "suspicion" to smaller numerical values than the verbal evidence description "hint" (Mean "hint" = 41 vs. Mean suspicion = 33).

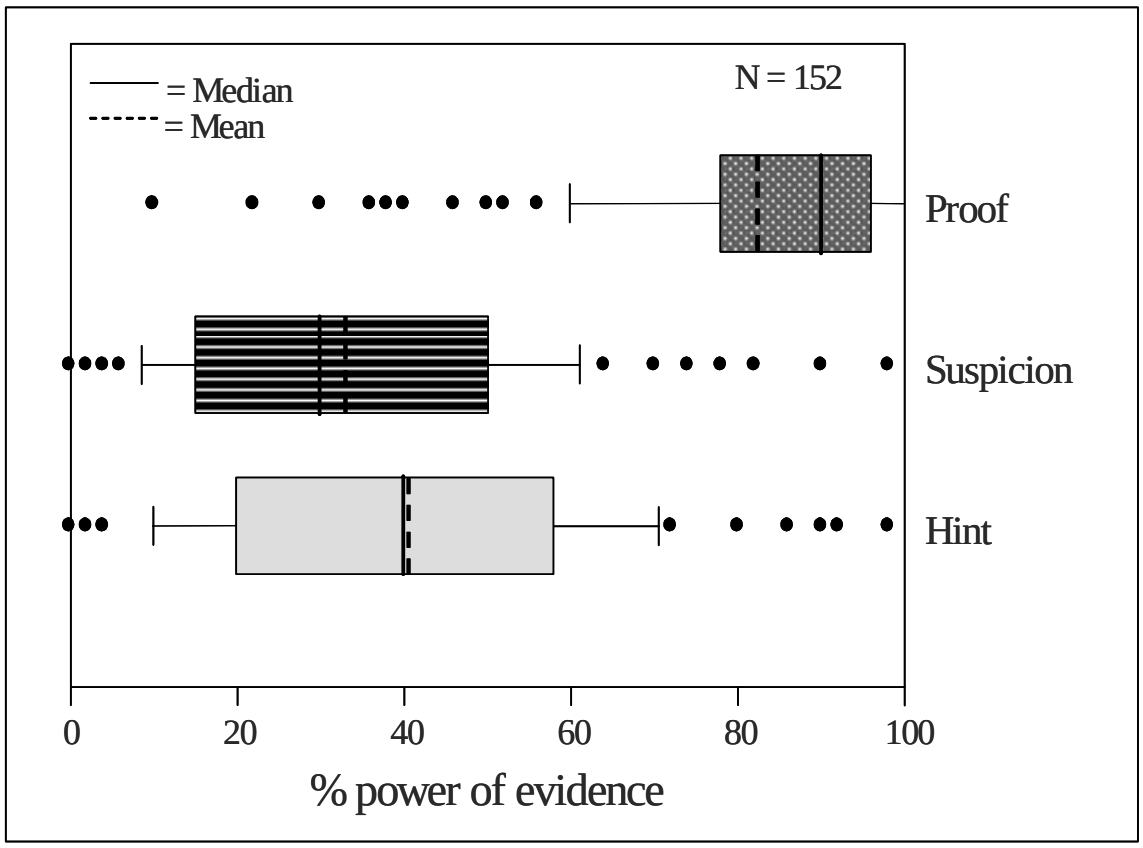


Figure 1: Participants perception of the three evidence categories (translated from German) (Thalmann, 2005, p.95).

**3. Conclusion**

The communication of uncertainty is a scientific challenge and poses multiple pitfalls for risk characterization and risk communication. When we inform non-experts about a risk we are confronted with the different unsolved problems with regard to uncertainty; and even more so in the face of the demand to enhance the risk-related knowledge ("risk literacy") of the citizens.

For instance, the mode of numerical uncertainty descriptions has an impact on its comprehensibility and subsequently also on the risk perception. Not only the choice of numerical description modes, such as RR or natural frequencies, is crucial for clear communication, also several problems exist with regard to verbal uncertainty description. Scientists often use hedge phrases to express a state of uncertainty. But these narratives, such as “probably no relationship”, “not likely”, “possible” and so forth, leave open a vast room for interpretation. The research on verbal uncertainty quantifiers distinctly shows the ambiguity and lack of clarity of verbal quantifiers.

A common approach to describe uncertainty in risk assessment and risk characterization is the development of a standardized set of verbal evidence categories. In particular with regard to the risk characterization of HF EMF, several reports use such a standardized set of verbal evidence categories to inform about the evidence supporting or mitigating the existence of a suspected heath effect (e.g. SSK, 2001, IARC, 2006, Röössli & Rapp, 2003). Recent research corroborates the ambiguous meaning of verbal evidence categories for laypersons; non-experts respectively (Thalmann 2005). Verbal evidence categories used in HF EMF risk characterization are often neither clear nor comprehensible. Further, new data indicate that the context in which these verbal evidence categories are embedded bears a serious impact on laypersons’ understanding of the existing power of evidence, too. (Thalmann, 2005b). Another noteworthy point is that, contradicting general expectations, an explicit definition of these verbal evidence categories might enhance laypersons’ understanding only to a limited degree.

In the light of these results one can conclude that the impact of risk communication, using such verbal evidence categories, cannot be controlled. In other words we can not be sure what the other side – the addressee of the information – will understand and how they will interpret our information and, more generally, how it will affect their risk evaluation in the given case. Possible side effects in such situations might be a misinterpretation of the existing power of evidence: E.g. an over- or under-estimation of the factual evidence supporting / mitigating an adverse health effects by non-experts – by the public. A consequence could be biased risk decisions or biased risk perception. With regard to the still existing controversies on telecommunication technology, the use of such verbal evidence categories in risk characterization might lead to a perpetuation and “emotionalising” of the discussion, due to a probably avoidable confusion and differences in the understanding of the factual evidence between different non-experts, for instance interest groups, or the general public.

In order to enhance the risk literacy of non-experts / laypersons, innovative approaches of evidence / uncertainty characterization must be established. All the more, we have to keep in mind: uncertainty will always be an inherent part of risk assessment. Clear and comprehensible risk communication has to enable accessibility of all-important elements of risk characterization, including unbiased information about both, pro and cons, support and mitigation of the hazard potential with regard to a specific area of concern. Moreover, the remaining uncertainty has to be addressed adequately. And, certainly, communication tools have to be evaluated in the light of their clarity and their appropriateness to enhance non-experts’ risk-related knowledge (see Wiedemann, Schütz, Thalmann, 2008). Innovative approaches should consider these demands in order to successfully promote a better understanding of risk and risk related issues in the public.

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## What Do Laypeople Know About Mobile Communication? A Mental Model Approach

M-E. Cousin and M. Siegrist
ETH Zurich, Institute of Environmental Decisions (IED), Consumer Behavior

**Abstract**
Setting up new mobile phone base stations has become a difficult task. People are often unwilling to accept base stations in their neighbourhoods because they fear serious health consequences. To prevent health effects, the construction of mobile phone networks is strictly regulated and controlled by the government. Nevertheless, people distrust these measures and call for banishing of base stations to outside their villages. Several questions arise: Why does the risk perception of laypeople differ from that of responsible experts? Is this discrepancy due to different standards of knowledge? What do laypeople normally know about mobile communication?

Few studies have examined laypeople's standard of knowledge and how it is related to their risk perception of mobile communication. To fill this gap, we used the 'Mental Model Approach' to show how lay mental models of mobile communication differ from those of experts. Focusing on these qualitative aspects opens a pathway to the improvement of communication between laypeople and experts.

The applied methodology included three steps: First, an expert model reflecting experts' understanding of mobile communication was created by means of a literature review and open-ended interviews with 16 experts. This model was used as the basis for semi-structured interviews with 31 laypeople, which were conducted and evaluated in a second step. In a third step, the prevalence among Swiss citizens (N=775) of the different beliefs about mobile communication identified in the interviews was determined by a mail survey. The questionnaire contained general knowledge questions as well as items about perceptions of mobile communication.

The results of these three steps can be summarized as follows: The expert model allows important insights into the structure of the complex problem field. Lay interviews and survey results indicate that the general public is familiar with diverse aspects of mobile communication but shows specific knowledge gaps and misconceptions. The resulting problems for risk communication can be illustrated by the example of base station construction. The detected knowledge gaps concerning the interaction patterns between base stations and cell phones as well as laypeople's exposure estimations could be responsible for the increased risk perception. Perception measurements also highlight the influence of affects and benefit on risk perception. These results provide hints on how to improve future information materials about mobile communication but at the same time also question the very importance of knowledge enhancement without first nurturing trust.

## 1. Introduction

Mobile communication is an expanding and highly valued technology, and the ever-increasing numbers of users and use rates for Switzerland impressively show this (BACOM, 2007). Mobile connections necessitate a network of base stations. In contrast to cell phones this aspect of the infrastructure arouses suspicion. People are often unwilling to accept base stations in their neighborhoods because they fear serious health consequences.

To prevent health effects, the construction of mobile phone networks is strictly regulated and controlled by the government. Nevertheless, people distrust these measures and call for the banishing of base stations to outside their villages.

Considering the fact that it is the cell phone that predominantly contributes to an individual's exposure, concerns regarding base stations are astonishing. Missing knowledge about mobile communication and its functionality could be named as one explanation. Different actors provide information about mobile communication to the public, but the usefulness of this information remains unclear. Several difficulties concerning information provision and diffusion must be mentioned.

First, it is a highly demanding task to direct the public's attention to available information. Most people are only interested in information about mobile communication when they are concerned about a new base station site-selection project. Second, if citizens are consciously searching for information, they often find a large amount of contradictory facts provided by different actors. This contributes to confusion or even suspicions against some information providers. Human information processing is biased; negative information is given more attention and is perceived as trust worthier than positive information. As a result, risk perception may increase because laypeople pay more attention to information about negative health effects of EMFs (Cvetkovich et al., 2002; Poortinga and Pidgeon, 2004; Rozin and Royzman, 2001; Siegrist and Cvetkovich, 2001; White et al., 2003). Third, the issue of mobile communication is complex and multi layered. It includes a lot of technical aspects that are difficult for laypeople to understand.

Little research has addressed the question of whether the information provided by authorities is understandable and helpful for laypeople. In effect, not much is known about risk perception of mobile communication (e.g., Ruddat et al., 2005; Siegrist et al., 2003; 2005; 2006; Wiedemann et al., 1994) and how knowledge may influence this perception. To the best of our knowledge, no systematic approach has examined these questions. Therefore, we used the 'Mental Model Approach' to gain insights about laypeople's knowledge about mobile communication and possible health effects.

The 'Mental Model Approach' by Morgan et al. (2002) is guided by the belief that "effective communication must focus on the things that people need to know but do not already" (Morgan et al., 2002, pp. 19). The aim of this approach consists of providing the information people need to make informed decisions. To this end, not only the views of experts but also the beliefs of the targeted public are systematically analyzed.

This systematic approach allows to measure the effectiveness of the realized communication and to improve prospective risk communications. The authors of the approach propose a five-step methodology (see below) to achieve these goals. The aim of the present report is to give a short overview about the applied methods and the main

results of the survey, while focusing especially on the knowledge issues. Detailed descriptions of the single steps and the results can be found elsewhere (Cousin & Siegrist, 2007a, b).

## 2. Applied Methodology

The 'Mental Model Approach' was applied successfully in different risk issues such as radon (Atman et al., 1994a; 1994b; Bostrom et al., 1992), climate change (Bostrom et al., 1994; Read et al., 1994), and even for perception of low-frequency electric and magnetic fields (Morgan et al., 1990). As mentioned above, the complete 'Mental Model Approach' consists of five steps (Morgan et al., 2002, pp. 19-21):

- Step 1: Create an expert model
- Step 2: Conduct mental model interviews (laypeople interviews)
- Step 3: Conduct structured initial interviews (survey)
- Step 4: Draft risk communication
- Step 5: Evaluate communication

The present report focuses on the first three steps. It provides a short overview about the applied methods and main results.

### 2.1. Step 1: Expert Model

#### 2.1.1 Aim and Method

The expert model attempts to provide a comprehensive and collective representation of all aspects experts consider as relevant for the conceptual understanding and risk perception of mobile communication. A graphical model, which captures all collected qualitative elements, had to be constructed. For this purpose, literature from different relevant fields (e. g., WHO, 2000; 2002; 2005; 2006) was reviewed and analysed to create an initial model and a guideline for the expert interviews.

The interviews started with general and nondirective questions that allowed respondents to express their beliefs unconstrained by the researcher's expectations. Most experts were asked to create their own model and explain their construction. One key question guided this task: "What do laypeople have to know about technical aspects of mobile communication in order to estimate potential risk and health concerns and to make informed decisions?" In addition, social and individual influence factors on risk perception as well as the specific situation in Switzerland were discussed.

In this way, the initial expert model was successively improved with each interview. The final expert model provides a template for characterizing laypersons' appropriateness, specificity, and category of knowledge in later steps of the process (Morgan et al., 1992, pp. 2050)

#### 2.1.2 Participants

Based on an actor analysis for Switzerland, 16 experts were selected and interviewed. The selection of interview partners was carefully planned to include as many different viewpoints of accredited actors as possible. Interviews lasted between one and two hours and were recorded and transcribed.

### 2.1.3 Main Results

The final expert model (see Cousin & Siegrist, 2007a) is subdivided into three parts:

*Part 1: Technical Aspects*

This part highlights the technical functionality of mobile communication and factors that influence the amount and the type of radiation. The model distinguishes between radiation of base stations and cell phones and also considers other radiation sources. All pathways result in the 'Total of Electromagnetic Radiation' or the individual exposure dose.

*Part 2: Individual and Social Aspect*

The individual aspects can again be split in two main parts one of which is the 'Human Organism' or the biological base. This aspect consists of, for example, the genome or the health constitution. The other part consists of all psychological processes like information processing and risk perception. Both aspects are embedded in a social environment that interacts with the individual. For example, the public discussion about mobile communication and the behavior of the involved actors influences information processing.

*Part 3: Interaction, possible Health Consequences, and State of Research*

This third part mainly describes the interaction between the 'Total of Electromagnetic Radiation' (part 1) and the 'Human Organism' (part 2). It points to the biological effects discovered by research and highlights the level of uncertainty.

### 2.1.4 Discussion

In summary, the final expert model depicts a broad variety of aspects and influence factors in regard to risk perception of mobile communication. The model reflects the beliefs of a group of Swiss experts.

It can be stated that experts overwhelmingly agree on technical as well as on social and individual aspects. Yet, beliefs about scientific uncertainties and probabilities of possible health effects differ to some degree. The lack of causal models explaining bodily changes and the difficulties in appropriately measuring radiation results in uncertainty and offers space for personal opinions and speculations. All experts affirm that long-term effects of low-level EMFs are still unknown and require further research. Experts had different views about precaution measurements and regulation approaches. For example, they would fix radiation standards at different levels.

## 2.2. Step 2: Lay Mental Models

### 2.2.1 Aim and Method

The goal of the second step was to uncover the mental models of laypeople. In a similar fashion as for the expert model, the objective was to collect as many qualitative aspects as possible that were considered relevant by laypeople. At the same time, laypeople's knowledge about mobile communication as well as possible misconceptions or knowledge gaps were assessed.

The expert model was used as a guideline for the laypeople interviews. For each field of interest, different questions were posed starting with more general, nondirective questions and leading to very specific ones. Interview began by the interviewer prompting the subject to talk freely about the issue of mobile communication ("Tell me about mobile communication."). Allowing respondents to say all that came to their minds gave a first impression about their knowledge. The follow-up questions were then adapted accordingly. Respondents were asked to elaborate on each of the topics, they mentioned. If they failed to mention a field of interest, the interviewer introduced a related open question and went on with more detailed ones. In this manner, it could be assured that all aspects of the expert model were covered and the full depth of a respondent's knowledge was tapped. Besides the questionnaire, some visual tasks using pictograms were employed to assess people's beliefs about exposure conditions. All interviews were recorded and transcribed.

### 2.2.2 Participants

Two groups of participants were recruited from the German-speaking part of Switzerland. Sixteen persons can be described as laypeople without special affinity to mobile communication and were recruited by flyers or personal request. The other 15 persons were active base station opponents, whose names were found in newspapers or on citizens' action committee homepages.

### 2.2.3 Main Results

The evaluation of the lay interviews generates a broad set of beliefs regarding all three parts of the expert model. For this report, we focus only on the insights about the technical aspects.

The comparison between laypeople and base station opponents showed a lot of similarities but also some differences. Various levels of knowledge concerning the technical aspects of mobile communication were found in both groups. Most opponents, however, knew more than average laypeople. They were better informed about laws, exposure standards, and network construction processes than laypeople.

Focusing on common misconceptions, it can be said that most respondents were not aware of the radiation consequences of interaction between base stations and cell phones. For example, people communicated the belief that cell phones and base stations radiate equally all the time. They ignored influence factors on radiation exposure, such as distance between the base station and a particular cell phone as well as shielding effects. Therefore, network construction and the resulting radiation consequences for the public were not entirely understood. Distance from base stations was considered a protection factor, and larger quantities of base stations were associated with more radiation. Radiation power and field strength changes of the cell phones themselves were highly underestimated.

The most striking discrepancy between experts and laypeople was the degree of certainty about health effects of radiation. All opponents and all but two laypeople were certain that high-frequency electromagnetic fields could harm human beings.

### 2.2.4 Discussion

Lay interviews provide a rich set of beliefs about mobile communication. The beliefs were compared with the expert model. Thus, a set of misconceptions and knowledge gaps were identified. The lay interviews also highlighted a lot of qualitative aspects concerning the social and individual dimension of the problem field. To achieve the next step, a representative mail survey, it was necessary to select specific aspects of the gained insights.

### 2.3. Step 3: Mail Survey

#### 2.3.1 Aim and Method

The first two steps provided a large set of beliefs about mobile communication, but they do not allow for drawing any conclusion regarding the relevance of the found beliefs and knowledge components. A structured questionnaire was designed to estimate the prevalence of each belief in a general population, and employed in a representative mail survey. This questionnaire attempts to cover, as far as possible, all relevant concepts identified during the expert and lay interviews.

The questionnaire covers a variety of issues. First, respondents were asked to rate mobile communication on different dimensions like personal affect, perceived benefit, and perceived risk and to indicate their trust in the diverse actors involved. Second, a set of 29 knowledge questions including some visual tasks using pictograms was presented. Table 1 shows some of the items utilized. In a third part, people's concerns about health-related issues were measured. Respondents were also asked to rate several statements related to mobile communication. Demographic characteristics were recorded at the end of the questionnaire.

Table 1: Selected technical aspects from the final expert model with item examples

| **Technical aspects** | **Item examples** |
|---|---|
| Radiation in general | The higher the frequency of any radiation, the more dangerous it is. |
| Base station | The radiation given off by mobile phone base stations constitutes a large proportion of the total electromagnetic pollution we are exposed to. |
| Cell phone | It is possible to buy cell phones that give off less radiation than others. |
| Interaction patterns | Generally speaking, a mobile phone network consisting of many low-powered base stations results in lower levels of exposure to radiation than a network that uses fewer high-powered ones. |
| Regulation | The maximum permissible radiation levels for mobile phone antenna masts are more strictly regulated in Switzerland than in most other European countries. |

#### 2.3.2 Participants

The questionnaire was mailed to a representative sample selected from the Swiss phone directory. 765 questionnaires were ultimately included in the data analysis (response rate: 41%). Forty-two percent (*N* = 311) of the respondents were women, and fifty-eight

percent (*N* = 435) were men. Reported age ranged between 19 and 105 years, with a mean age of 51.62 (*SD* = 16.60). Respondents were better educated than the general Swiss population.

### 2.3.3 Main Results

Only 26% of the respondents reported that they had actively searched for information about mobile communication. Self-reported knowledge (6-point-scale: 1=no knowledge, 6=good knowledge) fluctuated across various knowledge topics. Respondents reported knowing more about risk (*M* = 3.42, *SD* = 1.3) than technical aspects (*M* = 3.03, *SD* = 1.32) or legal aspects (*M*= 2.27, *SD* = 1.24).

People's objective knowledge depended on the topic. Correct answers ranged between 10.6 % and 74.1% (answer possibilities: true, false, don't know). Respondents had reasonable knowledge about cell phones (mean of 49% correct answers based on 9 items) and even base stations (mean of 33.8% correct answers based on 5 items), but most of them ignored the interaction patterns between cell phones and base stations (mean of 21.2% correct answers based on 6 items). Knowledge about radiation in general (mean of 19.3% correct answers based on 2 items) and about regulation was also low (mean of 21.7% correct answers based on 2 items).

Perception measurement (affect, risk, benefit) of cell phones and base stations revealed findings along the expected lines. Base stations were perceived as significantly more negative, riskier, and less beneficial than cell phones (6-point-scale; 1=negative /not at all, 6 = positive / total agreement). The conducted regression analysis ($F(3, 745) = 78.92$, $p = .000$) shows that 'affect', 'perceived benefit', and 'knowledge about interaction pattern' explain about 24 % of the variance of the dependent variable 'perceived risk of base stations'. Affect ($\beta = -.41$) influences 'risk perception' considerable more than 'perceived benefit' ($\beta = -.12$) and 'knowledge about interaction patterns' ($\beta = .06$).

## 3. Discussion

The degree of people's health concerns related to EMFs of mobile communication varies as a function of their personal involvement. In general, mobile communication is seen as a minor risk (Ruddat et al., 2005; Schreier et al., 2006) when considered within the context of other environmental and health risks. People are usually not motivated enough to actively obtain information about this topic. The situation changes completely when a new base station is placed in their neighborhood. In that case, some people do search for information and find a rich set of contradictory facts. It is highly demanding for laypeople to assess the trustworthiness of this information as well as that of its authors. People are confronted with expert dissent as well as with the uncertainty of the database (Schütz & Wiedemann, 2001, pp. 44). In addition, less attention has been paid to laypeople's initial understanding of mobile communication and what is necessary for them to get an intuitive feeling for the nature and magnitude of a risk.

An objective of the presented study was to achieve a better understanding of laypeople's information requirements in regard to mobile communication. Therefore, the mental models of laypeople were compared with the mental models of experts (Morgan et al., 2002). The misconceptions and knowledge gaps identified were then explored using a representative sample (German-speaking part of Switzerland). Only one third of the

participants actively searched for information about mobile communication. Compared with self-reported health concerns (73%) related to mobile communication, this result is surprising.

Results suggest that laypeople's objective knowledge varies considerably across the different topics. Knowledge about cell phones and base stations is widespread, but 'knowledge about interaction patterns', 'regulation', and 'radiation in general' is lacking. The knowledge about interaction pattern is considered particularly and highly relevant for the full understanding of EMF exposure. Qualitative and quantitative results stress that people misperceive the exposure contributions of cell phones and base stations. They underestimate the contribution of cell phones and are not aware that the amount of radiation emitted depends on factors like distance to the base station or shielding by walls. In fact, most people ignore that their cell phone is also an antenna and has the same functionality as a base station. They perceive distance to the base station as a protecting factor, yet all the while the fact that they themselves hold an antenna close to their heads goes unheeded.

In spite of these findings, the role of knowledge for risk perception cannot be fully assessed. It is difficult to evaluate the interaction between risk perception and knowledge because most respondents had a low level of knowledge. Therefore, more research is needed. The effect of specific knowledge provision could be tested in experimental settings. The approach also allows for information provision not just focused on an aggregated public but for specific groups and individuals within their specific social and institutional contexts. For instance, information for a general public and for citizens concerned by a new base station could be adapted accordingly.

Risk communication addressed to laypeople should consider the unveiled misconceptions or knowledge gaps. Worried cell phone users can be shown simple and effective ways of how to reduce their daily exposure dose. The knowledge about interaction patterns between base stations and cell phones is also useful in regard to base station placement. Base station opponents often wish to remove base stations from residential areas in order to reduce their daily radiation exposure. Again, the 'homemade' radiation by their own cell phone and its dependence on factors like distance to base station and shielding are ignored. Perhaps knowledge about these interaction patterns could help people to accept the necessary proximity of base stations. However, even adequate knowledge about technical aspects is probably worthless if there is a lack of trust in the involved actors. Therefore, it is important to invest in accurately timed and open communication.

As long as it cannot be satisfactorily documented that EMFs of mobile communications are innocuous, people have to deal with uncertainty. Information about technical aspects cannot compensate the uncertainty and the health concerns, but they can help people, establish accurate beliefs about exposure and give them helpful behavioral guidelines. This can help to qualify their fears and anticipated health consequences.

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# Information Campaigns and Public Understanding: The Example of Mobile Telecommunications

Julie Barnett and Lada Timotijevic
University of Surrey, Guildford, UK

## Introduction

The focus of this short paper is upon exploring the effects and the meaning of information provision around the possible health risks of mobile telecommunications (MT). The paper will unfold as follows. First, we will outline some of the present policy context around information provision in the UK. Second, we will report some data from a survey conducted as part of a programme of research commissioned by the Mobile Telecommunications Health Research Programme (MTHR) in the UK exploring public awareness of two leaflets produced by the Department of Health[1]. Finally, we will report on an initial exploratory analysis of some qualitative data from the MTHR project that looks at the meanings that people may attribute to information provision that are unrelated to the content of the information itself. This work is in progress and is being developed using data from a range of risk related domains. In the current paper, the analysis is based on data generated by a series of focus groups exploring public understandings of uncertainty and precaution around the possible risks of mobile telecommunications[2].

## Information provision as a policy tool

Providing information is often a preferred policy tool of government and increasing attention is paid by policy makers to the provision of information. Several policy variants of information provision can be identified[3] including public education campaigns, reporting and disclosure requirements, labelling, and advisory services. Information is seen to be key to increasing awareness, facilitating choice and informed and responsible decision-making. There is currently considerable policy attention on, for example, how to best provide clear and effective information that is trusted in contexts that are increasingly characterised by a proliferation of information from a wide range of sources, which may contest or conflict with each another. Within the National Health Service for example, an 'Information Accreditation Scheme' is being developed 'to deliver a nationally recognised way to reassure people that the health and social care information they access is from a reliable source'[4]. Other work draws attention to the way in which citizens can

[1] See also: Barnett J., Timotijevic L, Shepherd R and Senior V (2006) Public Responses To Precautionary Information From The Department Of Health (UK) About Possible Health Risks From Mobile Phones, *Health Policy,* 82, 240-250.

[2] For a full report of these focus groups from a different perspective see Timotijevic L & Barnett J (2006) Managing the Possible Health Risks of Mobile Telecommunications: Public Understandings of Precautionary Action and Advice, *Health, Risk and Society,* 8, 2, 143-164.

[3] Ledbury *et al,* 2006, Understanding Policy Options, Home Office.

[4] http://www.dh.gov.uk/en/Policyandguidance/PatientChoice/Choice/BetterInformationChoicesHealth/Informationaccreditation/index.htm

have – and are having – a powerful role in creating or reformulating public information[5]. The recent series of reports published by the Better Regulation Executive[6] notes a range of constraints on the effectiveness of regulated information[7] as a policy tool and has developed a series of 'tests' that should be used by policy makers to determine how appropriate and efficacious information provision is likely to be as a policy tool.

Despite both a proliferation of information and a heightened focus upon its potential value, the relationship between information provision and influencing behaviour however remains unclear. There may not be clear or positive relationships between information provision and awareness or between awareness and attitude. A similar lack of relationships may exist between attitudes and actions and in turn between intention and actual behaviour. A report considering the role of information provision in effecting change summed it up thus,

> *"Providing information does not necessarily change attitudes, and changing attitudes does not necessarily cause a change in behaviour"* [8]

**Information and awareness of possible risks from mobile phones**

Turning our attention to the domain of MT and by way of a brief introduction to the UK context, in 2000 the Independent Expert Group on Mobile Phones recognised scientific uncertainties around the possible health effects of mobile phones and recommended that a precautionary approach should be taken. The main recommendation relating to public information was that a leaflet providing clearly understandable information on health related aspects of mobile phone technology should be widely circulated and available at the point of sale. Following this, two leaflets were produced by the Department of Health (DoH) – one about mobile phones and the other about base stations[9].

A series of studies commissioned under the Mobile Telecommunications Health Research Programme explored public reactions to the communication of a precautionary stance, the public appetite for information about the possible health risks of mobile phones and the meaning of information provision in this area. As part of this, public awareness of the leaflets and the advice they contained was assessed. As noted above, this paper will report results from both quantitative and qualitative components of the research, the former consisting of a nationally representative survey using face to face interviews conducted with 1742 people in November 2004, and latter from a series of focus groups. (Full details of the samples and methods used for these studies can be found in the articles referenced in footnotes 1 and 2).

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[5] Mayo, E & Steinberg T (2007) The power of information, http://www.cabinetoffice.gov.uk/upload/assets/www.cabinetoffice.gov.uk/strategy/power_information.pdf

[6] See Better Regulation Executive, November 2007, Warning: Too much information can harm.

[7] "Regulated information is information which Government requires third parties – such as businesses – to provide to individuals making a purchase, or using a product or service, in a personal capacity" BRE.

[8] *Carrots, sticks and sermons: influencing public behaviour for environmental goals* Demos and the Green Alliance, for Defra, December 2004. (http://www.green-alliance.org.uk/publications/PubCarrotsSticksSermons/).

[9] Department of Health (2000), Mobile phones and health. London, Department of Health; Department of Health (2000) Mobile Base Stations and Health. London: Department of Health.

It is important to note that at the time that the DoH leaflets were produced there were no baseline assessments of public awareness or evaluations of the effect of the leaflets – although one piece of qualitative research exploring the area of risk literacy noted that awareness of the leaflets was low[10] considered. The work being reported here explored levels of public awareness and recognition of the content, some four years after the leaflets were first published. Additionally and building on the previous qualitative work we were also looking to accumulate further evidence in relation to an ongoing debate in the literature - as to whether precaution in the face of uncertainty increases concern or provides reassurance.

*Awareness of the Department of Health leaflets*

We measured awareness of the leaflets by asking people whether they had come across them. We chose not to set a more demanding criteria (for example, asking whether or not they had read them). 15% of the sample reported coming across the mobile phone leaflet and 10% were aware of the base stations leaflet. Both the literature and personal communication with policy makers suggested that there was no particular level of penetration for the leaflets that was being aimed for. Although the Stewart Report initially said that the leaflets should be distributed to every household, the follow up report by the NRPB in 2004[11] reported that about nine million had been distributed through, for example, doctors' surgeries, post offices and libraries.

There were no differences on any demographic variables between those who had and had not come across the leaflets. Unsurprisingly, given that one route for dissemination of the leaflets was at point of sale, those who said they had come across the mobile phone leaflet were more likely to be a phone user (chi square = 5.37, df = 1, p= .02). If the aim was to further target this group and strengthen this relationship, this might be achieved by routinely including leaflets in the box containing a new phone rather than simply within the discretion of the point of sale interaction. Those that had come across the leaflets had significantly higher levels of agreement with the general trust item, "The Government provides all relevant information to the public about possible risks of mobile phones" than those that had not. It is not possible to discern the direction of causation in this relationship, however it is clear that one challenge to emerge from this for those charged with disseminating information is how to increase awareness of information when its source is distrusted.

*Awareness of leaflet content*

The DoH leaflet on mobile phones draws attention to three behaviours that can be adopted by those that choose to minimise their exposure to radio waves: keeping calls short, those under 16 minimising non-essential calls and taking account of the Specific Absorption Rate (SAR) associated with the handset[12]. We asked people to select three

[10] Petts J, Wheeley J, Homan J, & Niemayer S (2003) Risk Literacy and the Public: MMR, Air Pollution and Mobile Phones, Department of Health, London.

[11] National Radiological Protection Board (2004) Mobile Phones and Health, Documents of the NRPB, Vol 15, No 5, Didcot, NRPB.

[12] The SAR value is the amount of energy from radio waves absorbed by the body when using a mobile phone.

pieces of practical advice that they believed had been issued by Government from a list of eight. Key results here were that

- 'Keeping calls short' and 'discouraging non-essential calls for those under 16' were both correctly identified by over 25% of the sample.
- 9% recognised that consideration of SAR values was Government advice.
- 23% of respondents spontaneously said that none of the advice emanated from Government.
- 53% did not correctly identify any of the advice as coming from government.

**Discussion**

*Precaution: concern or reassurance?*

We conducted both qualitative and quantitative work to explore the effects of adopting a precautionary stance (see the articles cited in both footnotes 1 and 2 for an overview of this). Overall this work (as well as that conducted elsewhere[13]) indicates that there is little evidence to substantiate the policy position that a precautionary stance will reassure people and lessen their concerns. Indeed research results – especially from quantitative work - tend to be in the opposite direction. In our survey we found that in relation to all three pieces of advice given in the mobile phones leaflet – around 50% of people said that this slightly or greatly increased their concern. However, it is perhaps more significant that for those that were initially more concerned about uncertainty – i.e. those whom it might be seen as especially important to reassure - all three pieces of precautionary advice were associated with greater concern/less reassurance.

Overall then, this research provides us with some insight into the profile of public responses to the Department of Health information leaflets and identifies some of the factors that underlie these responses. It is important to reflect at this point however that as far as levels of awareness of the leaflets go it is hard to make any assessment of how satisfactory this level of awareness is. There is no indication in the relevant literature in this area to suggest that there were particular aims for the leaflets to penetrate a particular percentage of the population. Similarly there is no indication of what base line areas of public awareness existed. It is similarly unclear exactly what the aims of the Department of Health information leaflets were. Certainly, as noted above, it is implicit that one aim is to facilitate appropriate behaviour change for those that are concerned and wish to reduce their exposure to radio waves.

At the outset we noted the policy focus on using information provision as a way of facilitating informed choice. Following this we noted some parameters of public responses to the provision of information about the possible health risks of MT and the associated advice to those who wished to reduce their exposure to radio waves. In the following and final section of this paper we will use some qualitative data to explore people's understandings of information provision around mobile telecommunications and to look at the ways in which people make sense of having – and not having - information.

[13] See Wiedemann P M & Schütz H (2005) The Precautionary Principle and Risk Perception: Experimental Studies in the EMF Area, Environmental Health Perspectives, 113, 4, 402-405.

*Meanings of requests for information*

Focus groups enabled a more in-depth exploration of the meanings made, and responses to, the information contained within government communications about mobile telecommunications health risks. Unsurprisingly, bearing in mind the levels of awareness of the leaflets seen in the survey data, in the focus groups participants claimed that they largely unaware of the Department of Health leaflets. Commonly linked to this were claims about the importance of having and of wanting more information.

So, in contrast to the quantitative work that was focused around information that was provided, the qualitative work also allows examining the meanings attributed to the provision of information but also enables a focus upon how the apparent absence of information provision is interpreted.

There was broad agreement within the groups that it was important that information was provided on known and uncertain risks such as that from mobile phones. In line with literature on this point, the need for independent information - which was linked with "trusted sources" such as academic or medical bodies – was stressed.

> *Well, again, any report or statistics can be to an extent manipulated to read however you want it to read so I think it's quite important who's doing this and who's producing the report. If it's paid for by the government, by people employed by the government, you've got to at least wonder how accurate it is and how the figures are presented. Obviously it makes a difference to your interpretation of it. Any research should be done by an independent person. (Concerned, not Active)*

One claim about the purpose of being provided with information was in order that it could guide their decision-making and behaviour, as indicated in the extract below:

> *P1. Lack of information.*
> *P2. Obviously not knowing something is scary.*
> *P3. Yes, and you can't make a judgement without knowledge. One can't decide whether you're able unless you know what you're deciding about really." (Concerned, not Active)*

In the following excerpt the speaker suggests that having been given information at least allows you to take responsibility for your actions.

> *As the gentleman said, it is like smoking. I was a smoker for 30 years; I don't smoke now but that choice was mine. I felt that if it never caused me pain I would carry on smoking. Then I got flu and I've never smoked since. The same option I think would apply to mobile phones. If you're given the warning then it's down to you at the end of the day whether you say yeah or nay, whether the benefits outweigh the dangers. (Brighton, 50+)*

This quote also implies that people may choose not to attend to the information, which is equated with a warning. Others claimed much more explicitly that although they wanted information this was not because they were open to, or intending to change their behaviour in the light of it.

Although the way in which particular pieces of information were seen to be empowering in so far as they provide the recipient with choices, the existence of a proliferation of multifaceted perspectives was considered to have a paralysing effect both for information seeking and possible behaviour change. In the excerpt below hearing multiple perspectives was seen to make it more difficult to know what the truth of the matter is:

> *"You've heard so many false issues stated on different subjects. You put everything down as the same thing. You think are they telling the truth or are they not telling the truth. You don't know and you're stuck in the middle. Because you know the mobile phone people want you to use your phone a lot because they're making money so they're not going to tell you the truth. (Brighton, 50+)*

It was clear in all of the groups that the sense that is made of an information campaign is not just about the content of the information it conveys. The merit and relevance of the information is set against the wider context in which the information is communicated. The trustworthiness of the source of the information and the motives of the stakeholders arrayed around the issue, the identity of those the source purports to represent and the ostensible objectives of the communication are all considered relevant in informing responses to the information. When considering what would encourage changes in phone use behaviours one participant explained:

> *I think if we were faced with what I perceived as conclusive evidence… and I don't think we ever will be because I don't trust the phone companies and I don't trust the government. (Brighton, 30-50)*

For the most part, information was seen as a "right" associated with the democratic principle at the heart of the Western society it was seen by some that seeking out information was a responsibility and an act of citizenship.

> *"We have a responsibility. If we don't believe the government or if we do or don't, if we don't believe reputable scientists, if we trust our own instincts better, I still think it is our responsibility as voting citizens to look for the information and make our own judgement based on our own education". (Kew Gardens, Non-active Parents)*

Some invoked lack of information as an indication that no risk was present. This was associated with trusting the potential providers of information. On other occasions both the nature of information that *was* provided and the *absence* of information were used to warrant claims about conflicting or hidden agendas of industry or about the presence of risk. Information about the risks of a technology that ran alongside a highly visible commitment to the development of that technology was clearly seen as problematic.

An information campaign is judged against other instances that signify the "true" position of a proponent of a perspective. In the case of mobile phones, the merit of a precautionary approach is judged not only in the context of what government said was being done about the risks and the information content provided, but also in relation to

the broader context of risk regulation and management of what may be ostensibly unrelated risks.

*Information and behaviour change*

Participants claimed a range of reasons why information about mobile phones would not affect their frequency or duration of their calls. First, in a situation where the behaviour was seen as valuable, uncertainty about the possible health risks lessened the incentive to change phone practices. In the excerpt below certainly is initially held up as the situation in which behaviour change is most likely, though, as the remainder of the excerpt indicates, a transparently clear picture was not considered likely:

> *If they said it's conclusively bad for your health I think everyone would change. It's like salmonella with eggs; they tell you that and it drops off for two years and then it gradually creeps back up again. But if they conclusively said it was bad for your health I think people would think again. But I don't think we'll get an honest answer." (Brighton, 30-50).*

Contested information was also seen to provide a ready way of discounting any need to change behaviour.

> *We all have a certain cynicism for government but I don't know that it helps us, and it also offers us a cheap way out because, yes, I read in the press that this is the case; did the government really say that or is this the press's interpretation of what the government said? (Kew Gdns, Non-Protest Parents)*

Second, where the information was aligned around everyday behaviours that were highly functional – like mobile phone use - it was seen as highly unlikely that people would choose to change their behaviour. Third, changing behaviour was seen as unnecessary and an over reaction in the context of the multiple and transient claims that are made about risk.

> *"I think the problem is nowadays that when you sit back and look at everything you think, oh I shouldn't eat that, I shouldn't do that and you get to the stage where you hear and you think well, I shouldn't do anything, I shouldn't eat anything or go anywhere." (Brighton, 30-50)*

Related to this was the notion that if information was worthy of *real* concern and subsequent behaviour change, that it would be continually visible and persistent.

**Conclusion**

In conclusion these data have emphasised the value of making a clear distinction between information content and information provision. People initially make sense of the provision of the information bringing a range of evaluations to bear, largely independently of the content of the information itself. Where the focus was on the DoH leaflets we saw that over half of those that claimed that they had come across the leaflet were not able to recognise any of the key recommendations for behaviour change it contained. In addition, rather than reassuring, the information was linked more with concern. In the

light of the qualitative data we would suggest here that the provision of information – about possible uncertain risks around a ubiquitous and highly functional technology that has been strongly invested in by industry and endorsed by government - shapes perceptions of the sources of information and the context of risk regulation. This forms a particular context that warrants concern independently of any processing of the content of the leaflet itself.

It is also clear that there is considerable variation in the range and timing of information that people want. Some, for example, express a preference for a constant stream of information from those responsible for managing risks others consider it their own responsibility to access this information. It seems that these preferences in turn link to attributions of responsibility and to beliefs in personal efficacy for managing risks. Further research is needed to clarify these relationships.

The importance of distinguishing between information provision and the content of information was also evident in relation to the expressed willingness to change behaviour (or not). For example the amount and the nature of other (possibly quite unrelated) information campaigns is considered to be a relevant parameter in adjudging the requirements for changed behaviours: too many information campaigns diminish the relevance of the messages, regardless of their nature.

Further research in this area would be valuable in helping to clarify the contexts of information provision that may most strongly militate against consideration of its content. This is likely to be of considerable value for those charged with the communication of risk related information. It may also be possible to build links with established theories of persuasion[14] and to understand the impact of the contexts of information provision upon central and peripheral processing of information.

[14] Petty, R.E. & Cacioppo, J.T. (1986). *The Elaboration Likelihood Model of persuasion*. New York: Academic Press.

## Understanding Controversies Related to Emerging Risks

Olivier Borraz – CNRS
Danielle Salomon – Risques and Intelligence
Centre de Sociologie des Organisations (CNRS-Sciences Po)

### Introduction

Public authorities, international organisations and private operators generally have a limited understanding of how risks issues emerge. Whilst much research and development have gone into risk assessment, and more recently risk communication, fewer efforts have gone into gaining better knowledge of the mechanisms involved in the labelling of a particular activity as a risk. To take the case of EMF, apart from studies in the UK (Burgess, 2004) and in France (Borraz *et al*., 2004), limited knowledge is available to explain how exactly mobile telephony has come to be seen and managed as a (potential) risk for health. In most cases, regulators and operators alike undertake to manage risks without having any actual knowledge concerning the origins or the dynamics of the issue.

This lack of understanding will often lead them to make false assumptions. They will assume that the controversy derives from the introduction of a new technology within a population that lacks scientific education, is missing information, behaves irrationally, responds emotionally, needs more time to adapt, demands to participate in decisions on new technologies, or is misinformed by activists spreading false information. These elements will lead the public, according to them, to perceive the technology as a risk and thus demand that it be closely monitored, strongly regulated or not put onto the market. Hence, risk management and communication should aim to provide evidence that the risk is, either nonexistent or, if it is established, under the control of private operators and public authorities, while scientists are working on the remaining uncertainties.

Yet, these assumptions not only reveal a poor understanding of how risk issues come to be, but they may lead regulators and operators to undertake actions which will amplify the issue, rather than attenuate it. In other words, on the basis of assumptions which, as we shall see later, have received little empirical evidence, they will take measures which may in fact prove to be counter-effective or give credit to the idea that there is indeed a risk.

This situation thus calls for research aimed at providing specific knowledge on the factors, which contribute to the emergence of risk issues. But this can only be done if within regulatory processes, a prior distinction is made between risk management and risk issue management (Leiss, 2003). If we follow W. Leiss, risk management relies on scientific risk assessment to take decisions aimed at reducing exposure, probability of occurrence, outcomes in relation to a given hazard. Risk *issue* management implies understanding the internal dynamics of risk controversies in order to influence them toward a desirable outcome. In particular, risk issue management calls for a clearer understanding of why a risk controversy emerges around a given activity at a certain time and place; the role of different organisations in the amplification of the controversy; and the possible consequences of such a controversy. Only with such a distinction established can research on the dynamics of risk issues provide knowledge for risk regulation.

Furthermore, this distinction needs to be supplemented. When focusing on an activity such as mobile phone antennas and the process through which it has been labelled as a risk, special attention must be paid to the behaviour of public authorities and private operators and their specific stakes in the matter. Since, when addressing risk issues, they are also managing risks to their reputation, liability or profitability. H. Rothstein *et al*. (2006) suggest to differentiate societal risks from institutional risks: the former refer to threats to members to society and their environment, the latter to threats to regulatory organizations governing societal risks, such as liabilities, bureaucratic failure and loss of reputation. In other words, faced with risks issues, public authorities, along with private operators, attempt to reduce the different uncertainties in order to demonstrate that there is no risk, or that the risk is well identified and under control; whilst simultaneously avoiding any crisis or, should a crisis occur, mitigating the consequences for their organisation through blame avoidance strategies. But Rothstein *et al*. go further, arguing, "that the growing centrality of risk to regulation in the post-war years is less to do with a growth of societal risks, but is rather a consequence of the growth of regulatory frameworks to regulate societal risks and the need to manage the associated institutional risks of risk regulation." (Hood *et al*., 2006: 99). They insist that trade-offs between the two should be looked at carefully, particularly when public authorities manage their own institutional risks at the expense of societal risks, or when "the concentration on institutional risk management can shape the perception and management of societal risks." (*ibid*: 103). This behaviour has been clearly demonstrated for risk regulation activities in the UK (Hood, 2002) and in France (Borraz, 2007). Risk regulation regimes do in fact play a major role in the labelling of risk activities, albeit sometimes inadvertently.

Hence, not only must regulatory processes establish a clear distinction between risk management and risk issue management, each relying on specific types of knowledge but also they must delineate as often as possible societal and institutional risks, in order to reduce possible contradictions between these two sets of risks.

This paper has two aims. The first is to defend the need for a framework of analysis applied to controversies on emerging risks. Such a framework should supplement more traditional risk assessment procedures and provide risk managers with the necessary information to regulate risks, without having to turn to scientific experts for advice. The second is to question the assumptions on which risk communication often rests, in order to offer a wider acceptation of risk communication, one which may help to better understand the emergence of risk issues and provide guidelines for an effective strategy of risk reduction. Risk communication must be made distinct from risk assessment, in the sense that risk communication should not be undertaken by scientists, too eager to regain their lost legitimacy on controversial issues by communicating on their results.

## 1. A framework for understanding emerging risks

What is an *emerging risk*? Two characteristics may serve to define it. First, an emerging risk refers to an activity fraught with multiple uncertainties: these will be scientific or technical, as in the case of biological and health effects of RF or ELF; but they will also cover social and regulatory dimensions: in the case of mobile telephony, this refers to the behaviour of private operators, construction firms, local authorities or state services. As long as their behaviour cannot be easily understood, clearly interpreted, or anticipated, this will be a source of uncertainty in regards to mobile phone antennas. The main point

to be made here is that, albeit very different, these uncertainties all add up to the idea that an activity constitutes a risk given the many gaps in the knowledge and control capacities. Second, an emerging risk is a potential source of political or economic crisis. Even when there are no clearly identified victims or damages, or in very limited figures, activities that are deemed risky can lead to crises with strong consequences on public officials (loss of reputation, liability, protest) and economic activities (financial losses, loss of reputation). The mad cow illustrates this point perfectly, along with the controversy over genetically modified food.

Emerging risks, and the controversies that go along with them, are normal events in contemporary society. They are neither accidents nor flaws in governance structures. They cannot be expected to disappear in a near future, based on our capacity to provide better scientific knowledge, stakeholder participation or renewed governance structures. They are a feature of the world we live in.

Risk controversies are normal given the conjunction of several factors.

- First, the rapid growth and the even more rapid introduction of new technologies, which raise inevitable questions, doubts and reactions about their use, functions, effects.
- Second, a growing demand for the provision of safety by the state, in a context of greater social vulnerabilities due to economic transformations and reforms of welfare states (Castel, 2003; Lagrange, 2003).
- Third, transformations in the occupation of land space by different groups of the population, which provide opportunities for conflicts around the use of this space: many risk controversies are embedded in local contexts that have undergone socio-demographic changes.
- Fourth, errors in risk regulation regimes that lead to misinterpret and mismanage risk issues. This factor may seem anecdotic, but due to a lack of organizational routines, institutional barriers or cognitive limitations, due also to the large number of concerned actors and stakeholders, administrations in charge of an activity can be expected to make errors in interpreting a problem, provide unsuitable answers or simply fail in managing the dangers tied to an activity (Freudenburg, 1993).

These four factors have been applied to mobile telephony in order to describe the normality of contestation. It was shown that the roll-out of thousands of base stations in a short period of time in newly urbanized settings, with the reactions of private operators and public authorities acting as risk amplifiers, made local reactions quite predictable and easily understandable (Borraz and Salomon, to be published). These were qualified as normal, in reference to the theory by C. Perrow of “normal accidents” (Perrow, 1984).

In the future, it can be expected that more risk controversies will emerge. They should be considered as a standard feature of our societies, by which major changes in and between technologies, social structures and political institutions are governed. In other words, risk controversies should not be considered only *per se* but also in accordance to larger transformations. Risk is a product of these, along with a medium through which these transformations are governed.

**2. The dynamics of risk controversies**

If we accept that risk controversies are normal events, then this implies that *risk issue management* must become a central feature of governmental agencies in charge of regulating activities with potential health and environmental effects. A certain number of implications follow from this.

First and foremost, the emergence of risk issues must be considered as an inherently dynamic social process. This dynamics is fuelled by the competing attempts of various stakeholder interests to define or control the way a given activity (in this case mobile telephony) is introduced, operated, managed, monitored or supervised. Several stages in this dynamics can be distinguished (Borraz *et al*., 2004, 2006).

A first stage can be labelled *extraction*, whereby a given activity is separated from its "natural" or usual environment, to become isolated and fraught with uncertainties of different types: technical, scientific, social (i.e. relative to the behaviour of the actors in charge of the activity), regulatory (e.g. the implementation of public regulation, monitoring and supervision by public bodies). Without going into too much details, it is important to acknowledge that most risk controversies in Europe and in the USA these last 20-30 years were made possible through a process of extracting an activity from its context in order to make it perceivable and simultaneously available for action. In this process, the activity looses any familiarity it may have had, it is detached from the human and technical networks in which it was previously embedded, it is perceived as threatening and out of control.

A second stage can be referred to as *projection*, whereby the activity is thrust within a larger "controversial universe" (Godard, 1993) where it is linked to other risks or crises, and set within a framework of wider political issues. In other words, not only is the activity compared or assimilated to prior risks (e.g. EMF and asbestos in France, EMF and mad cow in the UK), hence suggesting a similar set of factors, a common narrative, but it is also politicised in order to illustrate wider issues: global warming, economic globalisation, the role of science, or the development of new technologies. During this projection stage, the activity gains consistency as an issue and can hardly be disregarded any longer by political authorities (Gerlach, 1987).

In the third stage, *agenda setting*, the activity is recognized as a risk by public authorities, who then call on scientific experts to "provide the numbers", even though they may feel the risk is primarily to their reputation or liability. In other words, while they may judge the controversy to be unfounded, they will nonetheless recognize a risk but will immediately seize scientific experts in order to provide a state of the science – rather than attempt to provide a more global answer, linking the different benefits or advantages of the activity with its potential risks. In so doing, they will often partake in the framing of the activity as a risk to public health.

Finally, during a fourth stage, *decision-making*, regulation is provided to reduce the risks, along the lines set by scientific experts, but with the clear intention of preventing any blame for public authorities should a problem occur in the future. Once the dynamics of emerging risks is recognized and the stages spelled out, several features need to be stressed that call for more research.

*Place*

It is often assumed, and there is widespread empirical evidence to support this assumption, that protest movements against unwanted activities will more often arise in areas inhabited by populations with the social, economic and cultural resources necessary to fight installations for aesthetic concerns, nuisances or property value (Logan and Molotch, 1987). Yet, research in the United States since the 1970s and more recently in Europe has documented the fact that protest can also occur amongst less well-off populations.

Studies on environmental racism or environmental justice in the United States singled out protest against environmental pollution in places where the populations, already experiencing forms of marginalisation, found further proof in their environmental situation that they were not being treated fairly, but rather were exposed to dangerous substances or activities within a wider set of injustices (Capek, 1993; Kroll-Smith and Couch, 1990; Bullard, 1994).

Studying protest movements in France around mobile telephony (Borraz *et al*., 2004), the spread of sewage sludge in agriculture (d'Arcimoles *et al*., 2001) or incinerators (Salomon, 2003), a similar phenomenon was observed: the populations protesting were not always those we expected to find, and part of the explanation lied in the local social and political context. In particular, these were places where populations experienced a sense of disempowerment or social vulnerability reaching far beyond the specific case of an antenna – or wished to defend a familiar environment they felt deeply attached to against an outside aggression. This experience can be related to places under deep social or economic stress, places undergoing important socio-demographic changes in their population structure, places with a lack of identity or an identity crisis. The absence of any institutional structure capable of taking their requests or questions into consideration adds to a feeling of abandonment or of lack of interest on the part of public authorities. Through the initiation of a protest movement, these populations were able to achieve some form of recognition, to start building a collective identity, to achieve a political capacity or at least gain an influence on decision-makers.

Hence, the hypothesis that there are places where protests against activities seen as presenting a risk to health tend to occur more frequently, and with potentially far reaching political consequences, should be further tested. It would give a clearer indication as to why people actually mobilise against mobile phone antennas or any other type of activity in their immediate environment. And it would question the fact that risk for health is the central concern of these movements.

*Loss of familiarity*

Familiarity is a common theme in the risk perception literature, in conjunction with other elements such as the dread factor (Slovic, 2000). Yet the mechanisms leading to a loss of familiarity have not been fully explored: why and how does a common feature of our environment suddenly become threatening, unfamiliar, and ominous? Mobile phone antennas have not always been perceived as threatening: when do people start noticing them and why? This question relates to the topic of extraction mentioned earlier.

Part of the answer lies in events, which bring attention to an activity and suddenly make it noticeable (e.g. an accident, media coverage, etc) (Kasperson *et al*., 1988). But another

part requires that we expand our conception of uncertainty. The social process by which an activity comes to be perceived as threatening is intimately related to the behaviour of public and private authorities in charge of the activity: it is often following the messages delivered or the behaviour adopted that doubts arise. This leads to enquiries by populations or NGOs, often on the Internet, that reveal information inconsistent with the answers provided by authorities. This has been largely documented in the literature on risk (Wynne, 1996). But the implications have not always been followed through.

The uncertainties, which come to be attached to the activity, derive from the process of searching for and finding information on a given activity, a process that is contentious by nature since competing sources will be found. Furthermore, uncertainties tend to cover scientific and technical aspects, along with the behaviour of the different actors in charge of the activity. Their behaviour will be seen as unpredictable, or untrustworthy, and by way of consequence the activity will be perceived as out of control (Fessenden-Raden *et al*., 1987; Fitchen *et al*., 1987). In some cases, public regulation can itself be perceived as a further source of uncertainty, notably its effective implementation.

In other words, loss of familiarity is itself a dynamic process, through which individuals or groups of individuals come to see an activity as fraught with uncertainties and not under anyone's control. These elements are interrelated, in the sense that perception of lack of control on the part of public authorities adds to the idea that there are scientific uncertainties and health risks attached to that activity.

*Conflict and controversy*

The social and political process of risk amplification is a highly contentious process, in which on the one hand new uncertainties are added all along to an activity, whilst on the other hand the activity is thrust in a wider context of conflicting issues in the realm of health, environment, ethics, economic growth, poverty, … This implies that the debate is not so much about scientific truth and getting the facts straight, than about the framing of an activity as a risk issue calling for specific actions by policymakers in charge of protecting the population.

Conflict is a central feature of risk controversies, it is part of their status as normal events: different organisations will have different interests and will oppose each other around the way the issue is framed. In the social amplification framework (Pidgeon *et al*., 2003), the different amplification stations (private organizations, the media, non governmental organizations, …) who receive and transmit signals relative to a risk event seem to operate as isolated entities. Yet, this is rarely the case: they have conflicting views and are competing to impose their definition of the issue (along, of course, with their solutions).

The implication for any risk issue management or risk communication strategy is that conflict cannot be avoided, since it is part of the process by which a risk emerges. Hence, the management of risk issues is about managing conflicts between different organisations in order to achieve some sort of a resolution. Local charters on mobile telephony in France between local governments and operators have not reduced the level of controversy, but they have attenuated the risk, i.e. reduced the potential for the controversy to turn into a full-blown crisis. But this implies that public authorities adopt a more neutral stance, in order to be seen as not directly involved with mobile phone operators, but more inclined to manage conflicts between different organisations.

The dynamic process through which uncertain risks emerge implies that the labelling of an activity or an object as presenting a risk is an outcome rather than a starting point in this process. This statement is a break with most social studies of risk, where the starting point is always some disagreement about the risks of a given activity. Even the social amplification framework takes as a starting point a "risk event", whose definition will be contested, but the controversy is from the start framed in terms of risk. Yet in most instances controversies start out around a whole set of problems related to an activity, and in the course of the activity's extraction and projection the framing of the issue will crystallise around the theme of risk.

In other words, risk becomes at a certain point a characteristic on which the different stakeholders agree to discuss, even if they disagree profoundly on the existence of a risk. The quality of risk is awarded jointly by opponents, counter-experts, the media, mobile phone operators, public authorities and scientific experts, who perceive risks to their own activity, accountability or reputation – what we termed earlier an institutional risk. But the risk is wider, in this instance, than a health issue. Yet it tends to be reduced to the latter.

**3. Communicating on emerging risks**

By lack of knowledge as to how risk issues arise and their particular dynamics, public authorities and private operators undertake actions which can in some cases directly lead to the qualification of a risk, and in most cases partake in the amplification (or what we called projection): either by defaults, denial that health is at risk, a reduction to a strictly scientific discussion, or siding with private operators and official scientists – instead of showing openness towards protest movements, whistleblowers or victims.

Risk communication, in particular, often rests on several assumptions, such as a lack of information on the part of the public or disinformation by ill-intentioned activists, which may lead to policy errors. Indeed, these assumptions have rarely been demonstrated. There is no available scientific evidence to date showing that the controversies around EMF, and more precisely mobile phones and antennas, are due to a lack of education or information, emotional or irrational behaviours, or irresponsible activists. Studies in risk perception may provide data on how the public evaluates the risks of mobile phones and antennas, but this does not imply that these perceptions are at the roots of the difficulties encountered by mobile phone operators and public authorities throughout Europe. The assumption offers a convenient explanation, one that can be acted upon (i.e. if clear information is provided, people will stop worrying), but the causal link between perception and protest is still missing. Furthermore, this assumption may even be misleading. Studies on environmental risks in the US have clearly demonstrated that the people opposed to a risky activity were generally much better informed than those who felt there was no risk at all (Fowlkes and Miller, 1987). Our own studies in France provide ample evidence of well-informed activists (Borraz *et al.*, 2004). Examples abound of retired men with technical expertise (engineers, military officers, highly qualified technicians) actively involved in opposition to base stations. Whatever their motivations, these are well-informed groups and individuals (Freudenberg, 1984).

Hence, communication aimed at providing information, encouraging people to behave rationally or disarming activists, may actually fall short of their target, or even amplify the controversy. This is the case, for example, when the information given out is contested by opponents who have diverging data (easily found on the internet); when messages are provided by authorities or experts who have in the past proven to be wrong or to have worked too closely with private interests; when activists are offered the opportunity to paint themselves as whistleblowers with little resources fighting against powerful lobbies.

Apart from a general misunderstanding as to how a risk issue emerges, these errors also reveal a misinterpretation of the role of information in controversies over risk issues. As we have already suggested, access to information is more often than not a determinant factor in the organisation of a protest movement. The difficulty in obtaining clear and reliable information from public authorities or private operators, contrasted with the easily accessible information found on the internet or through activist groups, exemplifies a situation in which credibility of the data derives not so much from the legitimacy of its source than the way it is accessed. Information which is easily found, which speaks to personal situations, which makes sense of a particular situation, tends to be perceived with greater trust than information deemed more distant in tone, formulated in general and abstract terms, and of little use in a local context. Moreover, emerging risks are characterized, as we have already specified, by conflicting interests and viewpoints: in such a situation, information is not only a question of data. Every action or non-action, decision or non-decision, behaviour, speech, silence, … becomes an element of information, which will be collected, analysed and interpreted by the different stakeholders. Given the diversity of stakeholders and the difficulty in coordinating them, this makes for a potentially confusing sum of information to be assessed by the different parties, one in which opponents will find ample evidence for their doubts concerning the safety of a given activity.

Hence, risk communication must be understood to cover these different dimensions. Reducing it to a one-way or two-way process of information-sharing misses a crucial point: that information is being produced, consciously or inadvertently, by a whole series of actors who are pursuing their own goals and interests and have, at least initially, little stake in coming to a consensus or even in entering a process of information sharing. Hence, a risk communication strategy must engage in a process of collective learning, where the information that is produced and shared serves first and foremost the different actors' understanding of the situation. This brings us back to the question of risk issue management, i.e. the capacity to understand and manage the dynamics of risk controversies, and this highlights the fact that communication is a central feature of a risk governance approach.

**Conclusion**

We will make three concluding remarks. First, managing risks is a full part of the state's role in providing security to its population against different threats. But risk issues are more than just about risks, they are an indicator of tensions and limits in the way our societies are governed. Hence, they should be managed as such, and not simply as problems having to do with science and rationality.

Second, following this recognition, risk should be conceived as an instrument for reforming the manner in which states provide security to their populations, in particular through the sharing of functions with non-state actors (private firms, NGOs or local governments).

Third, risk communication is a key component of risk governance, since it provides regulators with input from the different stakeholders. It offers the state an opportunity to reassert its role, to define responsibilities and to ensure that objectives in terms of risk reduction, mitigation or compensation are achieved. Non-governmental actors also find in risk governance an opportunity to establish their contribution to the reduction or mitigation of risks. Hence, communication is a way of establishing clear responsibilities among the different stakeholders, all the while reasserting the state's role in providing safety.

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## The EMF Controversy: Insights and Opportunities

Paolo Crivellari[(1)], Bruna De Marchi[(1)], Luigi Pellizzoni[(2)]

(1) ISIG, Institute of International Sociology of Gorizia
(2) University of Trieste and ISIG

### The controversy on electromagnetic fields

As a result of the proliferation of artificially produced electromagnetic emissions (employed in a wide range of activities, one of the most important being telecommunication), a new technological controversy has appeared in recent years, about so-called 'electromagnetic pollution'[1].

The controversy over EMF is largely connected with the mobile phone technology, which has known a very rapid growth in a limited period of time. The massive diffusion of mobile phones and the consequent changes in interpersonal communication patterns are so numerous and pervasive that they have been labelled the 'mobile revolution' (Burgess 2004, 30). The functioning of mobile phones is assured by base station transmitters, which employ electromagnetic fields to convey the vocal signals. Masts for transmitters have began to appear in the early 1990s and have multiplied at a high speed since the second half of that decade.

People's worries and concerns are multi-fold, involving:

1) Health aspects;
2) Land use;
3) Individual habits and societal trends

The main cause of concern is the interaction between electromagnetic emissions and the human body. While the effects of ionising radiations are certainly carcinogenic for humans, the effects of non-ionising emissions have not been ascertained yet[5]. The health aspects of the controversy are thus related to worries about long-term effects. Moreover, framing the problem in terms of health risks proves to be a winning strategy (Borraz *et al.* 2005), as it draws attention to the EMF case and attracts media coverage. Citizen groups

[1] The World Health Organization has ranked ELF as belonging to group 2b in the following classification of substances:
1) Carcinogenic to humans (group 1), such as tobacco and X rays;
2a) Probably carcinogenic to humans (group 2A) such as UV rays;
2b) Possibly carcinogenic to humans (group 2B) such as ELF, coffee;
3) Substances for which it is impossible to evaluate the negative effects (group 3);
4) Not carcinogenic for humans (group 4).

[5] The World Health Organization has ranked ELF as belonging to group 2b in the following classification of substances:
1) Carcinogenic to humans (group 1), such as tobacco and X rays;
2a) Probably carcinogenic to humans (group 2A) such as UV rays;
2b) Possibly carcinogenic to humans (group 2B) such as ELF, coffee;
3) Substances for which it is impossible to evaluate the negative effects (group 3);
4) Not carcinogenic for humans (group 4).

use health arguments to avoid the 'closure' of the controversy as negligible and the authorities' dismissal of the issue. This strategy works in different countries, where governments are keen to refer to (at least rhetorically) to a precautionary approach.

A second cause for concern is related to the use of the territory. Citizens feel dispossessed of the environment they live in (especially when mobile phone masts suddenly appear, which have been installed overnight or during summer holidays). Lack of information and consultation are major causes of citizens' protests. Also, people often feel that the national government takes away from local authorities the regulatory power over land use. Not least, local authorities may be blamed for their subjection to private companies and their unwillingness to make full use of their own regulatory powers. What is lamented is, in any case, the lack of proper planning.

Third, protesters often appeal to cultural values and social habits, advocating and praising a 'clever use' of mobile phones, especially for children. People, it is argued, have the right to profit from a novel communication technology, but they should also be encouraged to use it properly. This approach clashes against that of the interested companies, which promote continuous innovation (for example the UMTS) and encourage an ever-increasing use of mobile phones.

These three categories of concern are obviously related, even if they do not completely overlap. Research (e.g. Drake 2006) shows that among those mobilizing, some are concerned mainly (or solely) about health aspects, while others consider also land use aspects; some are content with the relocation of base stations, others fear the proliferation of transmitters, i.e. the pervasiveness of the technology.

**Public mobilization**

Mobilizations against base station transmitters began in the late 1990s and have remarkably increased in number and intensity since 2000. Protest can be organized by different types of groups[2]:

- Pre-existing associations, groups and committees already active against power lines or electromagnetic fields in general;
- Newly constituted groups or associations, both at the local and national levels;
- Environmental groups and organizations

Opposition to electromagnetic fields has some peculiar features. First, in most cases individuals who mobilize do not have any previous experience of collective action, even though a minority have already taken part in other environmental mobilizations or are active in the political sphere.

Second, people who mobilize against electromagnetic fields often gather a remarkable amount of technical, biological, medical and legal information on the issue at stake, thus

[2] Usually, group members contact counter-experts quite early and play a role as external specialists, as Roger Coghill in Northern Ireland, Alasdair Philips in Scotland, Roger Santini in France or Gennaro Di Giovannantonio in Italy. In some cases, the scientist can be one of the early promoters of a local protest against electromagnetic pollution (for example Angelo Gino Levis for the committees in Padua, Italy), thus wearing the two heats of counter-expert and protest leader.

building their own specific competence on the different aspects of the controversy (Crivellari 2006; Drake 2006).

Third, the *repertoire* of actions undertaken is quite ample, though usually excluding violent acts[3]. Typically there are three types of actions, alone or combined:

- Protest events (sit-ins, meetings in public places);
- Diffusion of information (public conferences, seminars, lectures in schools);
- Political lobbying (pressure on national or local politicians).

Fourth, groups, committees and associations often rely on counter-experts[4], who usually are not directly involved in experimental work, but collect and review the existing literature, formulating conclusions and recommendations. In some cases, counter-experts do not have a direct contact with citizen groups, but their writings (discussion papers, articles or books) circulate among the activists also thanks to the Internet. They are kind of 'virtual consultants'[5] whose scientific argument offer support to the protesters who like to define themselves as 'lay people'. Indeed, protesters are fully aware of the importance of the scientific and technical aspects of the issue and argue in favour of a 'sound' science. Counter-experts provide coherent and competent arguments, which may go against the procedures and results of mainstream research and highlight health aspects of the controversy, which play a strategic role in ensuring political attention as well as media coverage.

Finally, people who mobilize tend to make extensive use of the most recent information technologies. The Internet proves an excellent tool for many purposes, in particular a quick access to a number of different sources, which provide useful data and information on a wide range of aspects related to the electromagnetic fields. Also, protesters can easily keep in touch with one another by e-mail, also conveying practical information on relevant events, including lobbying or protest activities.

The evolution of mobilization is discontinuous. It is striking that protests began only several years after the appearance of base station transmitters. A recent research on the regulation of electromagnetic risk in five European countries (Borraz *et al.* 2005) shows that the intensity of the protest rose after the promulgation of national regulations on electromagnetic emissions. The authors maintain that the controversial way in which regulation developed in Belgium, France, Spain, Switzerland, and the United Kingdom may provide a plausible and enlightening explanation of the rise of the mobilization.

The main promoters of the risk controversy are the citizens, who protest against the proliferation of the base station transmitters. The well-known Nimby (Not In My Backyard) syndrome can partially explain the decision of citizens to oppose mobile phone

[3] It is the case of N. Cherry, who taught at Lincoln University (New Zealand) and of G. J. Hyland, lecturer at the University of Warwick (United Kingdom).

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masts. Nonetheless, it would be simplistic and incorrect to downplay the multifaceted aspects of the protest by pointing only to such feature. For example, protesters sometimes ask for the relocation of a base station at a greater distance from residential buildings, gardens, school, hospitals, and the like: a request that can be easily classified as an expression of the Nimby syndrome. Also, the contradiction between requesting the re-location of a mast while at the same time making use of mobile phones has been often underlined (e.g. Drake 2006). However, some other time protesters take issue with the overall proliferation of base stations, regarded as a consequence of the public authorities' inability to control the commercial strategies of the private companies, i.e. promoting an ever increasing use of mobile phones.

Actually, many protesters are ready to acknowledge the merits of the technology, but are against its distorted use. They claim that it is possible to make a wise use of cell phones and lament that the authorities are unwilling, or unable, to drive the technology according to the public interest, rather than acquiescing to the companies' ones.

Given all the above, it seems simplistic to label the opposition against base stations as mere Nimby-ism.

**Institutional and distributional aspects**

The scale of the problem is strictly related to the diffusion of the mobile technology. Overall, scientific uncertainties are reflected in the societal and legal spheres in many countries. Regulation and mobilization vary according to the country and are a function of the institutional and political context. Generally, the countries where state power is centralized, as France, witness the formation of national groups and associations, whereas groups and associations tend to be locally based, when local autonomy is stronger, as in Belgium, Switzerland and Spain (Borraz *et al.* 2005). Indeed in the former case land use planning pertains to the State, while in the latter it rests with regional governments. Italy represents a peculiar and somewhat anomalous case[6].

There are at least four different levels to take into account when dealing with the regulation of the EMF controversy: European, national, regional, and local. There can be inter-level and also intra-level problems. Inter-level controversies rise when two or more levels are in conflict with one another (for example as regards national and local regulatory competences). Intra-level problems emerge within the same level (for example when there are two conflicting decisions issued by the same administrative body).

National, regional and local regulations are country specific. At the European level, most important is the recommendation n. 519 of 1999 of the European Commission, which advises that the guidelines of the ICNIRP[7] (International Commission on Non-ionising Protection) be adopted by member states.

[6] Initially working within the IRPA (International Radiation Protection Association), the ICNIRP works autonomously since 1992, involving inter-disciplinary researchers in the fields of medicine, epidemiology, biology, and physics.

[7] The ICNIRP aims at producing independent advice on the electromagnetic waves. The mechanisms of cooptation are meant to guarantee the researchers' independence.

As to scientific research, it is carried out both at the international and national levels. The two most important international organisations promoting research on EMF are the ICNIRP and the WHO[8] (World Health Organisation). Academic research groups also conduct International and national studies.

Electromagnetic emissions derive from various sources, but people's concerns are mainly with radiations from power lines and base station transmitters. Power lines are necessary to convey electric current and satisfy the need for electric supply. Their benefits are evident for both consumer and industrial activities. People benefit extensively from this type of energy supply and practically everyone takes advantage of it. The diffusion of power lines date way back, but it is only rather recently that they started to cause public concern.

Problems related to power lines are numerous concerning the environment, aesthetics (visual impact), and siting (appropriate distances of power lines from dwellings industrial buildings). In many cases, buildings are more recent than power lines and have been built only after the installation of the latter, in the absence of a dedicated regulation. Whereas benefits from electric supply are equally distributed across the population, the same is not true for the connected risks, which is judged unfair by the affected citizens. Over the years, some solutions have been proposed to minimize the risk. One of these is to bury the lines in order to eliminate both their visual impact and the possible health risks at the same time[9].

Mobile phone technology is very recent. In its early development, the derived benefits were not equally distributed among the population, as cell phones were not widely used. Things changed quickly over a few years with their very rapid diffusion. Thanks to rapidly decreasing costs, they are no longer used exclusively by businessmen and affluent people. Benefits from mobile communication are now widely distributed, and mobile phones have become objects of mass consumption and status symbols at the same time.

The advantages of mobile communications are evident in a variety of situations, from emergencies to everyday working and private life. However, whereas the potential risks deriving from use are somewhat manageable at the individual level (controlling the number and length of the calls), the distribution of the overall risks is unequal, as only part of the population is exposed to electromagnetic emissions from transmitters, namely those people who live or work in their vicinity. Moreover, since companies pay the owners of land or buildings for placing base stations, there is a conflict between those who earn money from installations and those who feel their health or well being at risk. Many local administrations offer public land to this purpose, in order to both reduce this type of conflict and collect money.

Another controversial aspect is related to the mobile phones companies' undisclosed strategies of deployment of their networks. Corporate reticence does not favour citizens' understanding of the technical reasons of logistics choices (the real 'need' for a company to place a base station in a given place). Sometimes corporate secrecy has been invoked,

[8] The WHO began a research program on radiofrequencies in 1996. It also issues periodical reviews of the scientific literature.

[9] The problem with this solution is of costs. In some cases, it has been applied thanks to an agreement about between the electric company, the local authorities, and the citizens about the distribution of the expenses.

which is perceived by the citizens as a strategy for concealing relevant information. The problematic evaluation of the companies' development plans affects also the agencies in charge of authorizing the installations. With no access to complete information, it is difficult to assess whether a site has been selected out of sound technical criteria of efficiency or because it is just the simplest and/or economically most convenient solution.

Moreover, there is an ambiguity inherent in the legal status of the networks. Companies are holders of licenses as providers of a public service and actually they often invoke this argument to prevent any attempt to limit the development of their networks. However it is unclear, from a legal viewpoint, to what extent the provision of a public service may be conditioned by some private organization's commercial plans.

**The governance of risk**

The governance of the EM risk is very challenging. The issue includes a number of aspects (scientific, regulatory, judicial, economic, communicative, cultural, ethical, etc.) and the degree of success of the different governance approaches is difficult to evaluate.

The main actors involved are of three types:

- Public administrations (national and local);
- Citizen groups;
- Mobile phone companies

They typically have different stakes, goals and "philosophies" about participation, which some public administrations and most companies consider inappropriate, irrelevant or unnecessary. In many countries there is no legal obligation to devise inclusive policy procedures, which indeed are rather rarely designed and enacted. Another obstacle is the confrontational relation between protesters and mobile phone companies, both unwilling to sit at the same table.

As shown by research on risk governance in different fields (e.g. Gough *et al*. 2003, De Marchi e Tallacchini 2003, De Marchi *et al*. 2006), many citizens feel excluded from decision processes and claim they have the right, and should have the opportunity, to take part in the decisions relevant to their health, natural and social environments. Even when citizen committees are invited to take part in participatory process, necessarily only a few individuals are actively involved, as representatives of larger constituencies. These have to face a double problem of legitimisation. On the one hand, they are scrutinized by authorities and companies, which tend to dismiss their arguments as emotional, irrational, anti-scientific, and prejudicially opposed to technological development. On the other, they have to be recognized as legitimate representatives by fellow group members where no voting procedure is foreseen[10].

Central governments and local administrations have to meet requirements from the European Union and in the meantime are pressured by (opposing) requests from citizens and mobile phone companies. Their institutional task in to enforce regulation and their pragmatic interest is normally to reduce conflict.

[10] Usually protester groups have no formal statute and spontaneous citizen committees tend to have a horizontal structure, at least in the *statu nascenti* phase.

As a consequence, more inclusive policy processes can be an argument for candidates to local elections who want to show their commitment to citizens' needs and requests. Once elected, politicians do not always uphold their own commitments and do not embark in the challenging task of participatory governance. Often, elected representatives are caught between the opposite requests of companies and citizens, and many times entering into conflicts with both.

As far as the companies are concerned, they are often unwilling to engage in a public procedure. They claim that regulations are already into force and their commercial strategies can be neither disclosed nor undergo major revisions. Their strategy is often based on a withdrawal from the public arena, appealing to confidentiality or the non-existence of any formal obligation to engage in inclusive processes.

Many different solutions for reducing risk have been proposed, but no ultimate one has been agreed upon. The distribution of risk is linked to the intensity of the emissions, insofar as less powerful transmitters imply more transmitters (given a certain amount of traffic and duration of exposure). A first option aims at reducing the emission levels of transmitters. Micro-cells (transmitters with low levels of emission) are available, but companies are unwilling to take that as a general option (although occasionally applied), possibly because of the costs of installation and maintenance and the complexity of the resulting network. Moreover, the micro-cells option is a matter of disagreement even among protesters, as it would imply a much larger number of masts, albeit with lower levels of emissions.

Another possible way of minimizing the risk is the re-location of the phone masts in areas removed from dwelling and work places. However, in densely populated areas, it is difficult to find such locations. Moreover, if the transmitters are far from the mobile phones, more powerful emissions are needed, leading to bigger absorption of radiation by the human body. The co-siting (that is the positioning of transmitters of different companies on a same mast) has also been considered as a viable option to reduce risk, but it has often been rejected, because more transmitters on a same mast result in higher emissions overall.

Thus the question about the preferable technical solution has neither clear nor unique answer. The 'bounded choice' is between some dedicated areas where to concentrate installations (at the expense of those who live nearby) and an even distribution of less powerful electro-magnetic fields. The issue mixes ambiguously aspects of health with others of equity.

**Conclusion**

The EMF case bears some similarities with other risk issues, for example the controversy over genetically modified organisms (GMOs). In both cases scientific evidence on the potentially negative effects on human health has still to be fully assessed. Also, both cases show a similar evolutionary path. In a first stage of the EMF controversy, public protest was interpreted within the framework of the 'deficit model' in the public understanding of science (Durant 1999). It was maintained that only ionising radiations damage health while non-ionising ones don't. The so-called 'electro-sensitivity' was considered a matter for psychologists rather than biologists and medical doctors, and people's concerns

overall were dismissed as irrational and incoherent, attributed to lack of technical competence and inadequate information.

In a second stage, it was acknowledged that protests were an expression of social distrust in regulatory agencies and/or elected officials. Also there was some recognition of existing uncertainties, which justify some caution in the implementation of the technology. In the following stage, some experiences of citizens' inclusion in the policy process started. This opening may be due to a genuine belief in inclusion as a means to improve the quality of the policy process, or arisen from strategic considerations masking the actual intention of maintaining the current *status quo*.

In many countries the level of concern about EMF is still fairly high, but at present conflicts seem less heated than some years ago. Some explanatory hypotheses may be advanced. It may be that other issues have taken the floor, according to the 'public arena' model[11]. Or the policy approaches enacted may have been successful in limiting conflict. However 'success' has different meanings and connected criteria of evaluation, according to perspectives and goals. Quality assessment has to be directed to different aspects of the process, besides 'products' and final results.

What constitutes 'quality' in a policy process is not self-evident. For example, inclusion may be considered as a criterion of quality in itself, even if the desired outcome (e.g. conflict reduction) is not achieved, on the basis of ethic and political considerations (participation is fair and enhances democracy). And when a desired outcome (e.g. conflict reduction again) is indeed achieved, it can stand on different grounds. People may be satisfied with the level of protection ensured by the regulatory system or may agree that a certain type or amount of potential risk can be tolerated in the presence of significant benefits. Or else, people may feel that they have no actual opportunity to affect regulations and their implementation. In this case they give up in resignation rather than in satisfaction.

Certainly, a decline in the level of social conflict is not necessarily a measure of success and, by no means can it be considered the only one. To the contrary, conflict may play a positive role, for example in drawing attention to unforeseen or underestimated consequences of present choices, raising 'early warnings' (EEA 2001), exploring and promoting options which foster technology while taking into account people's needs, both material and not.

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[11] This model (Hilgartner and Bosk 1988) maintains that there is in any moment a competition in the public sphere between a number of potential 'social problems' that ask for attention, the selection among which depends on a number of institutional, political and cultural factors. When one particular issue takes the floor, other may enter a phase of slow or sudden decline.

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# The Democratic Aspect of California's Democratic Foresight Strategies for EMF: A Case Study in Stakeholder Participation

Raymond Richard Neutra
Albany, California

**Abstract**
California is a culturally, ethnically and politically diverse state, whose State Government is committed to inclusive public processes, with open meeting laws and strict public records legislation. The Division of Environmental and Occupational Disease Control of the state Department of Public Health has a long commitment to participatory processes in the conduct of research and risk assessment. When the California Public Utilities Commission through an open process decided that a precautionary policy analysis on Electric and Magnetic Fields (EMF) should be carried out, it established a $7 million Electric and Magnetic Fields Program. As part of this it mandated a stakeholders advisory group to advise on the research and policy analysis agenda. Representatives of northern and southern California citizens who had concerns about health effects were members along with representatives of the investor owned and municipal utilities, the brotherhood of electrical workers, the state parent teacher's organizations, the industrial hygienist professional association, the Academy of Pediatrics and others. Early on great focus was on procedural issues to assure that the unequal access to power of the various stakeholders did not enter into the advisory process. I describe the contributions of the various stakeholders to the conceptualisation and conduct of the program. The formation and deliberations of this group are still documented on the program website at www.dhs.ca.gov/ehib/emf , which, after 2008 will be found at www.cdph.ca.gov.

## Introduction

A precautionary approach to the world of possible technological hazards would involve four steps:

a) Nomination of a potential hazard, from among the many, for assessment
b) Forsightful assessment of alternatives including the status quo and precautionary research to inform that assessment.
c) Political process to choose a sufficiently good alternative or proceed with the status quo
d) Post market surveillance for side effects from the alternative chosen or the status quo.

California went through steps a), b) and c) with regard to power frequency EMFs and in the first two steps there was a level of stakeholder participation that satisfied all the parties involved. Step c) was carried out as a rather narrow regulatory procedure and only the utility companies were satisfied with the procedural and substantive aspects. This paper will describe the method of stakeholder involvement in steps a) and b) in which I was intimately involved representing the California Department of Health Services (DHS) as their employee. The opinions expressed here are mine and do not necessarily represent those of the department.

**Nomination Process for Expending Resources to Consider EMFs**

In 1992, as a result of the press interest in the Feychting and Ahlbom paper (1) on childhood leukemia, the California Public Utilities Commission (PUC) convened a group of stakeholders to discuss what, if anything the PUC should order the state's utilities to do with regard to EMFs. This group included concerned citizens, representatives of investor owned and municipal utilities, the International Brotherhood of Electrical Workers (IBEW), local environmental health directors and others. This was step a). After half a year of meetings around the state, paid for and staffed by the PUC there was a consensus that utilities should be able to provide free EMF measurements to owners, renters and employees using rate payer money but that these readings must be provided to renters and employees and not just owners and management. It was also recommended that utilities carry out no and low cost EMF avoidance up to about 4% of the project cost of new transmission lines as long as there was at least a 15% anticipated reduction in fields. The group also recommended that a $10 million dollar multi-year extramural research program be started in California and managed by DHS. It was to be policy oriented non-laboratory research since a federal laboratory program was initiated around that time. The research program was to be advised and guided by a stakeholder advisory group. There was other more far reaching recommendations for exposure mitigation for which consensus from the utilities could not be obtained but these were listed as well for the administrative law judge at the PUC to consider.

In November of 1993, after formal hearings to assess the stakeholder recommendations the judge issued Decision 93-11-013 which adopted with some modifications the consensus agreements of the stakeholders group. A $ 7 million dollar multi year program with stakeholder advice and involvement was part of this decision. DHS was free to structure the stakeholder process and up to $100,000 was available to pay for travel and expenses and $100 per day for non-utility stakeholder participation. The investor owned utilities were ordered by the PUC to pay for the program using rate's payer money and in proportion to their share of total utility revenues in California. The municipal utilities that are not regulated by the PUC nonetheless volunteered to contribute according to the same formula. In the end it took about 75% of the time of a health educator to convene, facilitate and plan the many meetings of the "Stakeholders Advisory Consultants" (SAC).

**Precautionary Policy Analysis and Research**

After conferring informally with the members of the original stakeholders group the SAC was assembled. It consisted of one concerned citizen from southern California, one concerned citizen from northern California a representative from the investor owned utilities, a representative from the municipal utilities, a representative from the International Brotherhood of Electrical Workers (IBEW), the Academy of Pediatrics, Industrial Hygiene Association, Parent Teacher Association, the PUC's Consumer Advocate office, Electric Power Research Institute, and an organization called the Environmental Health Coalition. The meetings were announced publicly six weeks in advance and followed California's open meeting law, even though it was not strictly necessary to do so. In practice all the utilities in the state sent representatives as observers and ex officio observers from other state agencies such as the Department of Education and the worker safety agency attended as well. The group first met in the fall of 1994 when the staff for the program had been hired. Early meetings were devoted to agreeing on the purpose of the SAC and its procedural rules.

It was agreed that the SAC was there to assure: the relevance of the research conducted, a balanced conduct and interpretation of the research, credibility, respect and dissemination. Rules of procedure included a commitment to avoid ad hominem attacks, respectful discourse, a method for assuring that members were called on in turn, a graduated voting system including a category "can live with it" to better gauge the "temperature" of the group around specific issues, writing down comments on butcher paper to assure that points made by all members were noted, careful meeting minutes approved by email soon after the meeting and morning and afternoon time slots for observers to make comments.

From the beginning the dynamics of the meetings were contentious with both the concerned citizens and the utilities suspicious of each other and of the government employees who were facilitating the meetings. The SAC insisted on having a chairperson that they elected who would represent them in the formation of the agenda for each meeting. This would prevent the government employees from manipulating the topics discussed. All members pushed for the maximum possible control over the program. The DHS made clear that they were advisory only but that we would try to abide by their judgments whenever possible. It is my perception that we kept our promise except on a few occasions mentioned below. The utilities were not monolithic in their positions, while they attempted t o present a common front, it was clear that this took some effort. Some utility companies seemed dominated by their legal departments and opposed gathering information or carrying out activities that might generate information useful for potential litigation at a later time. Interestingly the California Supreme Court declared a moratorium on all tort law suits for the duration of this research project citing its judgments as needed to guide subsequent proceedings. The early meetings were characterized by procedural wrangling. One citizen representative brought a law suit against DHS and the PUC because a subcontractor to a policy project, who was to provide cost figures for re-phasing and under-grounding power lines, routinely worked for power companies in other states. We argued that this expertise was needed, while the citizen argued with some justification that providing cost estimates that were not to the liking of the utility industry might jeopardize this contractor's future business and thus might bias him. This suit was taken to the Supreme Court, which decided not to hear the case, which was won by our department and the PUC at a lower level.

The SAC had a major influence on what extramural research was to be pursued. For example the utilities and the IBEW rejected our proposal that a policy analysis be carried out as to what options should be pursued if EMFs proved to be hazardous to workers. They both preferred to have this as a topic for negotiation within a larger context. Instead we agreed to develop a survey tool to estimate EMF exposure among a variety of occupations. On another occasion the SAC was against funding a follow up research project on EMFs and spontaneous abortion. They agreed to refer it to an ad hoc scientific committee including members that the utilities and the citizens separately nominated to the ad hoc committee. They abided by the ad hoc committee's recommendation to fund the research. The citizens were determined that property value impacts be one of the criteria to judge whether under-grounding or rephrasing was more cost effective. They also wanted to fund an econometric study to prove that EMF fears were affecting property values. It seemed to me that the utilities saw all of this as homework for future

tort law suits to obtain reimbursement for homeowners near transmission lines and were adamantly opposed to considering property values in the policy analysis or to funding an econometric study to assess the magnitude of the effect of EMF fears on property values. We determined that we would direct our contractor to consider property values but would only fund a study of the feasibility of econometrically assessing the effect of EMF fears on property values and costing out what such a study would cost. Both utilities and citizens were dissatisfied with this solution. The utilities had their lobbyist who attended the same sports club as our director arranged a meeting with the utilities to complain about our decision. The department held firm, but when the SAC heard about these back door negotiations there was a major blow up with all members scolding the utility representatives on the committee. Parenthetically, the final policy analysis showed that minor property value effects really added up, but that there was no way that property value savings to adjacent home owners from under-grounding lines could lower the rate fees of all of society that would be needed to underground those lines.

The SAC vetted all requests for proposal (RFP) to assure that the right research questions were asked. They also vetted the experts that were brought in as consultants to assess the responses to the RFPs.

The SAC insisted that the department carry out a risk evaluation, something we had not originally planned on. They commented, along with other members of the public, on our risk evaluation guidelines and the way we summarized the risk evaluation itself. They insisted that we assemble a scientific advisory committee and that they have no conflict of interest and had no part in the hot EMF debate. They vetted the candidates that the department presented to them and the utilities rejected one of them.

The utility stakeholders provided crucial technical information, although they were not willing to provide cost and reliability figures until the citizen stakeholders sued the PUC to make them provide some of this information.

One of the utilities volunteered to produce a video documentary on how to detect and correct “net currents” which were the major source of EMFs in California’s schools. They made 800 copies of the video, which we had the department of education distribute to all 800 school districts in the state.

One of the concerned citizens was an electrical engineer he and the utility engineers provided detailed comments on the decision tree models used for assessing options for power lines and for schools. All the SAC members influenced how the policy projects formulated their policy questions, presented their models and summarized their results. They had a major influence on what options were considered and what criteria were used to judge them.

The program provided the citizens with $20,000 to hire their own expert to check our contractor’s facts. They were satisfied when the two experts agreed. At the end of the program in 2002 (there were several no cost extensions of the project despite attempts by the utilities to terminate it when it became clear that our draft risk evaluation did not totally exonerate EMFs) the SAC had a final meeting in which the first totally unanimous vote was taken. The SAC asked the PUC to reopen its hearings and consider the results of the DHS risk evaluation and policy analyses.

**Political Process to Select Courses of Action**

Two years past and nothing happened. Then one of the utilities tried to build a transmission line through an affluent neighbourhood near San Francisco. In opposing the line, local citizens discovered that the PUC had never followed up on the $7 million project they had funded. Hearings were opened but of a scope and nature that frustrated citizen activists. They and one of the utilities requested that the DHS be called to summarize the results of the project but this request was ignored. In the end the PUC decided to extend the no and low cost avoidance policy of the early 1990s with some modifications but chose not to address the many other issues identified in our contractor's policy analysis. They refused the citizen's request to make the utilities document what no and low cost avoidance measures had actually been taken in the last decade or what degree of EMF reduction had thereby been achieved.

The California Department of Education convened some school officials and concerned citizens to discuss what to do with proposed new schools that needed to be placed closer to 66 kV lines than a previous set back regulation formed in the late 1980s had permitted. An "EMF" reduction plan in the design of the new schools was mandated in citing, design and completion with a no and low cost approach that sometimes might involve re-phasing of adjacent lines. The state architect will train local jurisdictions on adhering to these guidelines and avoiding net currents in new schools. The Department of Education's protocols and a guide on correcting net currents in old schools are available online (see web resources in references).

**Lessons Learned**:

1. Stakeholder participation, even when contentious can be constructive in the nominating phase and the phase of foresight-full assessment of alternatives and precautionary research.
2. Individuals representing stakeholder interests need to be selected so as to pursue their interests and ideologies with chivalry and honour.
3. The procedural rules of engagement need to be agreed upon and written down at the outset
4. The opposing views will assure the explicitness of such topics as:
    a. Fair procedural practices
    b. What research and policy questions are to be posed?
    c. Policy options to be considered
    d. Criteria by which these options are evaluated
    e. Rules for accepting evidence
    f. Inferential rules to be used to warrant claims made based on evidence
    g. How results are framed and "spun" (risk communication).
5. Stakeholders can bring information to the process that might otherwise be lost
6. The SAC would have benefited from having a member who could advance a libertarian/conservative philosophy yet be free of financial interests in the EMF issue. A conservative academic economist might have played this role. This is an important school of thought in American politics and having the industry members represent this philosophy led to its sometimes being dismissed as a position of narrow self-interest.
7. Having stakeholder due process involvement in steps a) and b) of the precautionary process but not in the subsequent steps leads to dissatisfaction and distrust.

8. If the goal of the PUC and the utility industry in pursuing steps a) and b) was to buy time until the EMF issue cooled down, the process was successful and probably cost effective, a single law suit might have cost as much as this program. DHS however entered the process in good faith and with the expectation that the PUC and the Department of Education and other state agencies would find the work generated to be helpful.
9. The program's web site holds a repository of flexible policy models which future policy makers can use as science increases or decreases our degree of certainty that EMFs can cause health effects. It also holds information about sources of EMF exposure in homes, workplaces, cars and commuting time and schools as well as the costs of modifying these sources.

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*Web resources:*

A guide on correcting net currents in old schools is available along with all the other products mentioned in this article on web site www.dhs.ca.gov/ehib/emf. The Department of Education's protocols can be found at www.cde.ca.gov/ls/fa/powerlinesetback.asp.

The location of this will be changed in 2008 but should be easily found by using a web search engine for either the California Department of Public Health or California EMF program.

## Evolution in the Social Perception of Risk Associated with EMF in Spain

Maria Jesús González
Consultant in strategic positioning and crisis management, NEARCO

**Abstract**

In the mid-2000 the media reported actions by citizenry associations in Spain opposing the building of mobile telephone antennas for fear of possible health effects from the electromagnetic emissions. These actions influenced greatly the deployment of these infrastructures making it difficult to contract sites and obtain municipal licences. Social opposition against antennas still remains despite the efforts made to communicate the state of the science, and the institutional consensus reached in Spain.

Public opinion is being shaped by a number of often-contradictory factors. Although the wide acceptance of the services offered by mobile telephony, there is a rejection of the infrastructure. There is, moreover, a distorted public perception of risks because no adverse health effects has been identified, and this state of opinion is being nurtured and legitimated by some groups or "experts" enjoying social and media credibility, and that misrepresent scientific incertitude and a so-called controversy. Some normative reaction as institutional response to the social alarm, the absence of communication campaigns by the Spanish health authorities, and the inexistence of an independent agency or scientific institution of reference in Spain, as well as the industry behaviour in the deployment of the infrastructures, are other various factors at the source of this crisis in public confidence.

The objective of the Spanish authorities and industry of obtaining social acceptability for the mobile telephone infrastructures has not been achieved. The administration and industry both lack in experience to handle situations in which public opinion receives contradictory messages and no common ground for participation by the civil society has been found. Filling this gap are "spoke persons" that strategically place themselves on the fringe of the institutions and question systematically any institutional action.

### Preliminary considerations

To place the Spanish case in context it should be noted that the roll-out of GSM in Spain was almost completed in 2001 with no significant problems observed during the installation process of 3 networks and 20,000 BTS, with the exception of a few very specific actions by local opposition groups that were already active against high frequency masts and other environmental issues.

Indeed in Spain, the penetration of mobile telephony has been one of the highest in Europe and the demand for service has not ceased to rise since then.

At the beginning of 2002 health fears associated with mobile phone masts, not with terminals or other sources of radiofrequency emissions, became a social, political and industrial concern. In fact, enormous media attention, claims by residents, local opposition groups and municipal decisions had slowed down the roll-out of GSM and 3$^{rd}$ generation and made it very difficult to erect masts.

It was at that time that the administration and industry became aware of the seriousness of the situation and realised *that regulations and controls of the emissions were not sufficient to respond efficiently to social concerns.*

**Analysis**

In 2001-2002, there was widespread ignorance about the technical operation of mobile telephony, the nature and effects of the electromagnetic fields, the state of the science, international recommendations on exposure limits and the rules and controls existing in Spain. Not only among lay people, but also among politicians, media reporters, and other professionals. This ignorance, and social pressure that called for immediate answers, caused political parties, the press, administrations and opinion leaders to launch contradictory messages not based on the state of the science or on technical knowledge.

At the same time, campaigners, picking up on the experience and messages of activist groups from abroad (Germany, Australia, USA…) and with reference to the Salzburg Resolution and so-called "scientific incertitude or controversy", established an association between antennas and serious effects on health, especially cancer. They showed suspicion about whether there were really grounds for the decisions adopted by the international bodies (WHO and EU) and the Spanish administration. The result was, and still is, a rejection of antennas that we can sum up in three negations: not in my back yard, not in my town, not more that 1 microwatt per square metre.

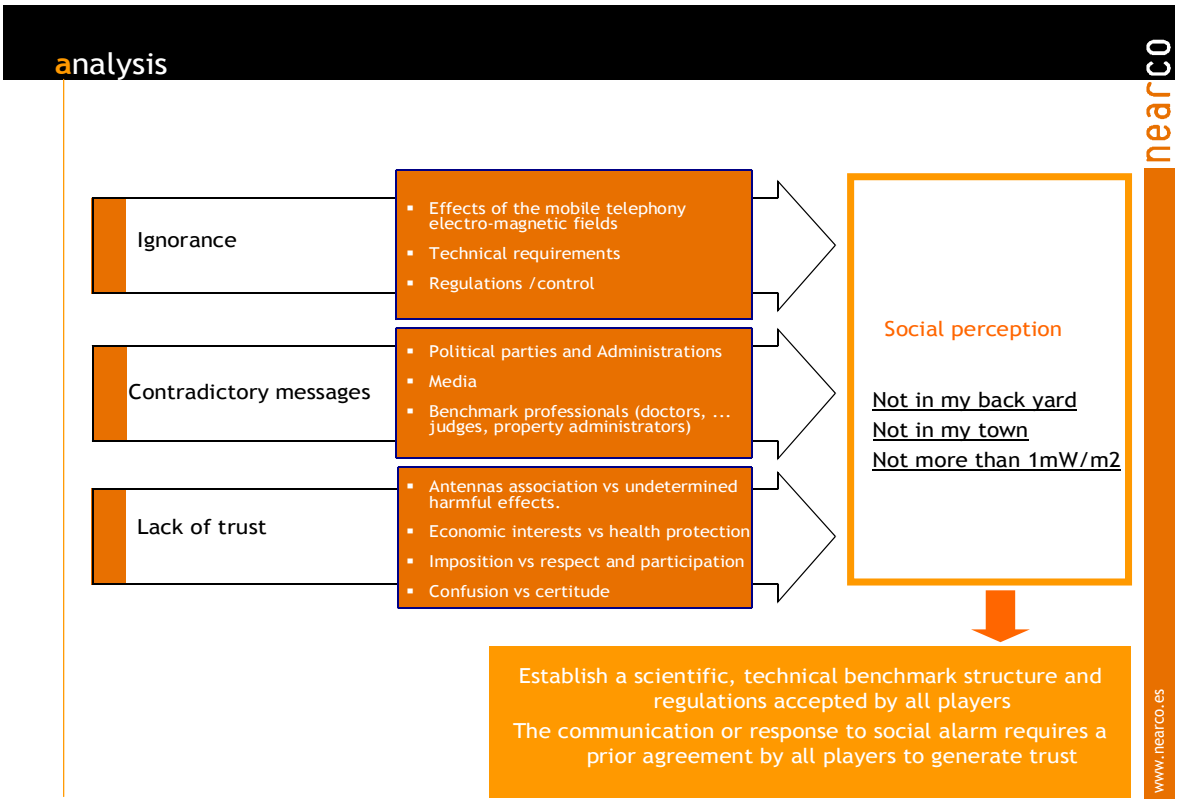


Figure 1. Evolution in the social perception of risk: Block-diagram of the proposed analysis.

With these items it was considered that the priority was to restore trust in the system of guarantees and, to do so, it was essential to establish a scientific, technical and normative common ground accepted by all players. And first of all, by the institutional ones, namely, administrations, scientific bodies, political parties, opinion leaders, consumer associations and corporations.

Once this basic consensus was reached, the message to the public would be clear and assured. Figure 1, shows the block diagram sketching our proposed analysis of evolution in the social perception of risk.

How to approach the response to alarm?

The line of argumentation followed by the administration and industry and already gathered in numerous judgements, one ruled by the Supreme Court just one year ago, can be presented in the following sequence: Science has studied the effects of radiofrequencies. There are limits fixed internationally by scientists (WHO, EU, National Experts groups and Agencies). There is no danger to health if we are below these limits.

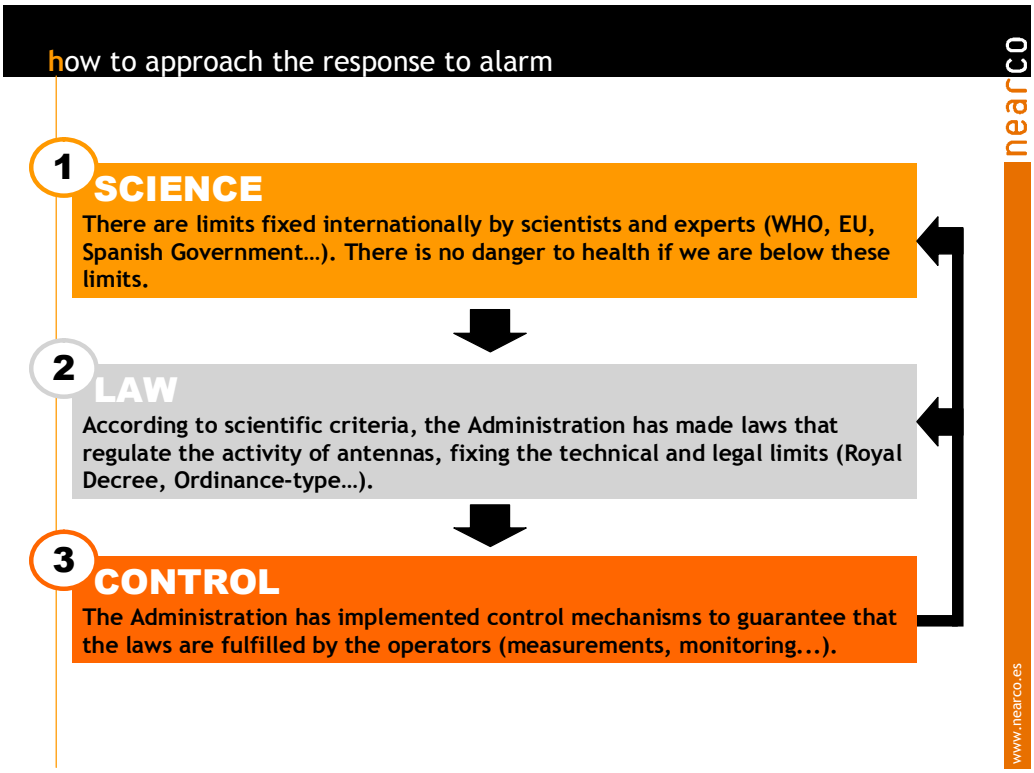


Figure 2. Implementing public protection and regulatory measures.

To ensure that the entire population is protected, including those who might be more vulnerable such as children, the elderly or sick, in 2001 the Spanish government approved a regulation establishing how industry must erect and operate antennas. Compliance with the regulation is carried out through controls of all the antennas before they finally start operating and, later, with annual certifications and measurements. Random controls are also performed and measured at the request of concerned parties.

Figure 2 presents our criteria on how to approach the response to alarm. It emphasizes scientific evaluation, and the implementation of public protection and regulatory measures.

**What has specifically happened in these years?**

In Spain, the network is currently composed of 4 Operators, 9 Networks, 3 Systems and 40,000 BASE STATIONS. Figure 3 presents a summary of the evolution in Spain, in our view, of the public perception of risk associated with EMF – as well as some implemented actions concerning it.

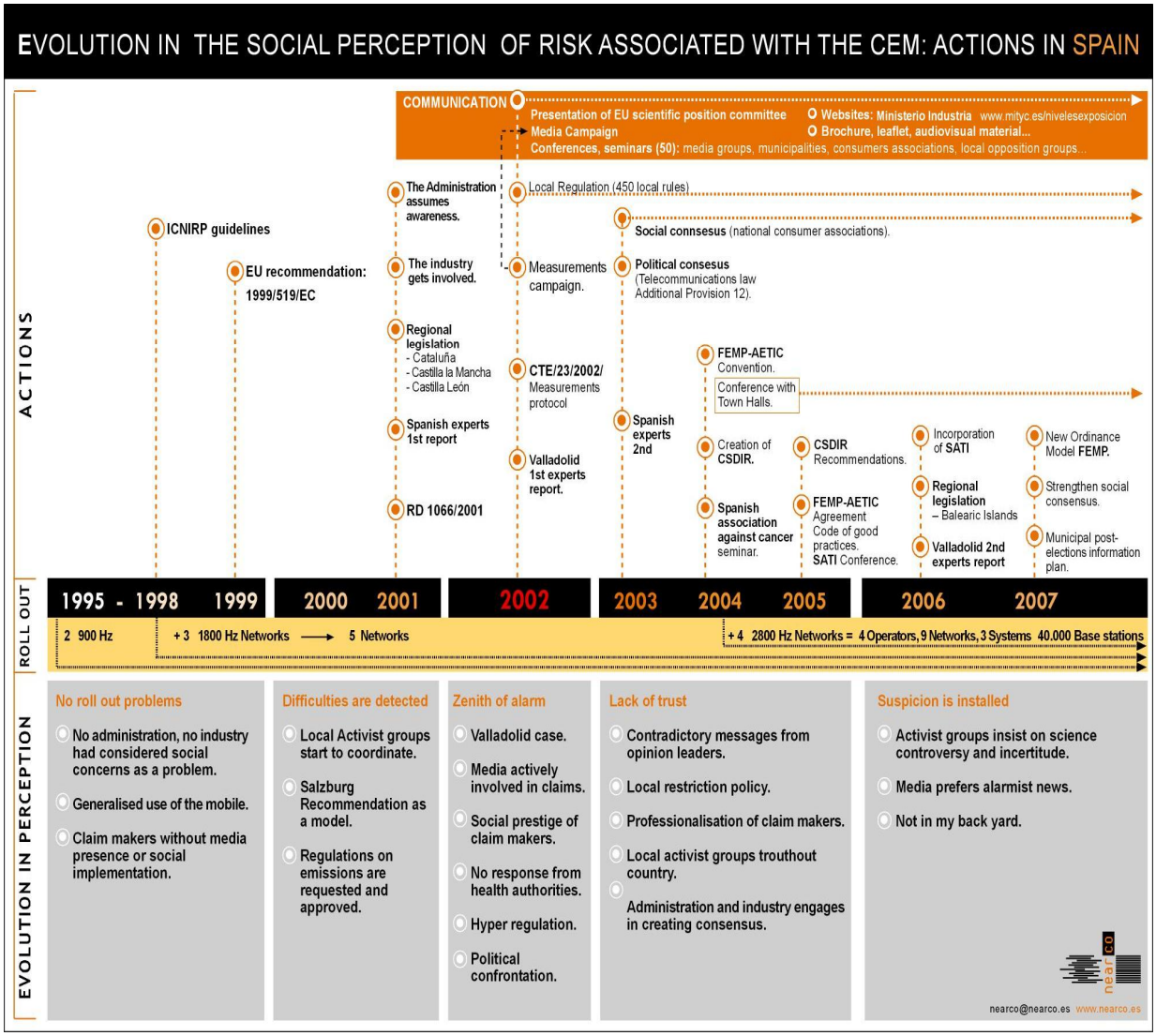


Figure 3. Evolution in Spain of the public perception of risk associated with EMF.

Until the year 2000, deployment was carried out without problems; there were hardly any anti-antenna groups and their activities had no repercussion in the media. Added to fast

acceptance and penetration of the service, this meant that no administration and no industry had considered public concerns as a problem.

In 2000 the difficulties began. Coinciding with the echo of protests by anti-antenna groups, in the international context, and recommendations by the Salzburg Conference, Local Activist groups started to coordinate their activities and gathering a very small but very active group of teachers and researchers around them. This is when the political parties, administration and industry all became aware that an anti-antenna movement was being formed and that their core claim had to be answered: antennas are dangerous because they emit without control.

The immediate response, and some believed it was sufficient, was to translate the 1999 European Recommendation on compulsory regulation by Royal Decree 1066 in September 2001, and include a very tight protocol of measures with it. In 2001, three of the 17 autonomous regions that form the Spanish State adopted their own regulations with different criteria to the Royal Decree, and there are now six. This attempt of being even more restrictive has not only failed to improve acceptability of antennas in those territories, but is used by the anti-antennas groups as an argument to show there is a real risk.

Among the control measures, the Royal Decree demanded that the emissions of all antennas be measured. This Plan was carried out in 2002 in a Measurement campaign of 24,000 antennas in the entire network and annual measurements of all new installations and antennas in around 100 metres of sensitive zones.

The year 2002 was when alarm hit its zenith in Spain. The fact triggering the media and institutional crisis that occurred at Christmas 2001 was a fourth case of cancer that was diagnosed at a school in Valladolid, 200 km. from Madrid. The parents association of the school accused it of being a cluster produced by the mobile telephone antennas located next to the school.

This case had such repercussion in the press that, in the weeks to come, the crisis reached proportions similar to that of dioxin or mad cow. Although the antennas were not mobile telephony ones, but rather fixed wireless antennas; the levels of radiofrequency emissions at the school were almost non-existent, mostly coming from two nearby FM broadcasting stations; and although a group of experts was formed with the agreement of the parents' association that logically did not find any connection between the telephony antennas and the illnesses, there is still widespread belief in Spain today that the children became sick with cancer because of the mobile telephony.

That was the moment when the prestige of the claim makers was secured, marking the media debate and triggering distrust in the institutions. The health authorities were of course asked to intervene to deny the false information and transmit calm. They unfortunately considered that since there was really no health crisis, as soon as the press stopped pushing the matter, the public would forget. This opinion has of course proved to be wrong.

Also, it is the local administration that receives the most pressure and responds with regulations. Today there are more than 400 municipal standards that would impede antennas from being erected in towns or less than 100 metres from sensitive zones. In practice, this would mean that a substantial part of the network is illegal from a municipal

point of view. It should be said that because in Spain the authorisations and control on all radio electric and emission aspects rests with the State, all base stations count on the necessary certifications and authorisations.

As the national, regional and local authorities started to get to know the health guarantees ensured by complying with the exposure limits and the effects of an unsuitable deployment policy on the development and quality of life, a dynamic was initiated to implement common tools and harmonised procedures.

The political parties that at first used antennas in their confrontation strategies fostered a political consensus that was defined in 2003 by including an additional provision in the General Law on Telecommunications, unanimously approved to favour deployment. Following the agreement reached in 2003 only individual politicians or minority parties, particularly in the electoral period, would use antennas as a confrontation factor.

All this was defined in the creation of a Sectorial Cooperation Commission between all the administrations that in June 2005 issued 14 Recommendations to facilitate deployment, which was also signed by the operators:

- Avoid duplication of procedures, facilitate simultaneous actions and reduce time limits for conceding licenses. To do this, a reference model for administrative procedures was adopted.
- Confirm that the limits of human exposure to electromagnetic fields are established in the RD 1066/2001, and should be universal and follow the recommendations of the scientific institutions of reference (WHO, EU…).
- Establish the bases of what should be the territorial infrastructure plans, the treatment for reducing the visual impact of the antennas, and the sharing of infrastructures.
- Promote agreements between the local administration and operators. This collaboration was set out in the 2005 Agreement that has given rise to the approval of a Code of Good Practice (December 2005).
- Create a technical committee to oversee the rollout of radiocommunication infrastructures, insuring the safe and orderly development of telephone antennas. Among its principal tasks will be to provide local administrations, businesses and citizens groups a reference to consult for technical, legal and health concerns, which will improve the information necessary for the roll-out of the antennas. This committee has been active since 2006 and includes a representative from FEMP.

But not only administrations and public institutions have been present during the process. All stakeholders have played a role:

- Spanish scientists have practically been absent from the debate as there is no Agency or Institution in Spain in charge of answering questions related to radio frequency fields. Although the Ministry of Health called upon a Committee of Experts that has issued two opinions, one in 2001 and a review in 2003, Spain has no specialised Agency or institution to respond to public concerns. It was only in 2006 that the Advisory Scientific Committee in Radiofrequencies and Health was formed under the auspices of the Complutense University of Madrid.

- Health stakeholders support reassuring messages on EMF health effects, such as the Spanish Association Against Cancer or the Spanish Society of Haematology.
- Judges, lacking information, at first ruled against antennas, applying the principle of precaution. Since the Supreme Court ruled in 2006 that the limits fixed by Spanish standards were based on the state of the science and EU and WHO recommendations, the situation has changed.
- National Ombudsman Reports underline lack of rationale behind EMF effects on health alarm.
- Operators have backed and encouraged the consensus strategy and participate in information actions.

**Communication**

In the communication scenario, the first thing to remember is that the press is highly receptive to arguments by claim makers and to presenting very sensational headlines about health risks.

Although the information and communication actions (more than 100 in five years) have generally been targeted at qualified collectives (town councils, doctors, consumer associations...), in a strategy to facilitate mediation work that will sufficiently transcend public opinion, at least 50 information conferences have been held with public participation to transmit information. Normally these are organized by, or with the participation of, consumer associations or universities. Informative pamphlets have been published for big consumer associations containing the state of the science and offering comprehensible and equilibrated information. The federation of Municipalities has also prepared informative material and reports.

Internet is the tool used by the Ministry of Health and the Ministry of Industry to give information. Both on their websites provide specific information as well as links to other relevant technical and scientific information sources. The Ministry of Industry offers on its website the possibility of consulting the measurements of all antennas and measurements at homes can be carried out free of charge upon request. This consultation possibility is also offered by certain Autonomous Regions such as Valencia and the Balearic Islands.

In Spain, industry and local authorities have been demanding from national authorities a public action or campaign to inform and counter the misleading information that systematically appears in the media.

**Conclusions**

Despite the ground covered and the efforts made, the objective of the Spanish authorities and industry to obtain social acceptability of mobile telephone infrastructures has not been achieved. One of the main reasons has been the lack of experience by the administration, and industry as well, in handling situations where public opinion receives contradictory messages and where no effective common ground for the participation of the civil society have been found. Making things a lot more complicate, moreover, there is a loss of public confidence in both the public administration and industry.

Filling this gap are "spokesmen" that place themselves on the fringe of the institutions (national and international) and question their actions. This has also resulted in the

appearance of professional "claim makers" in legal firms and measurement companies that offer their "advisory" services.

At the local and regional levels, authorities subjected to public pressure and political opposition did adopt very conservative positions on the issue. But now a clear political consensus and harmonisation measures have been implemented, and a more favourable attitude has been adopted for legalising the network. However, anti-antenna associations continue to claim that the present limits do not respond to the best science, that international institutions and administration are under pressure from industry, and that only their own selected independent "scientists" are reliable. Specifically those who backed the Salzburg, Alcalá or Catania declarations.

The health topic lends itself to demagogy and it seems likely that no new scientific evidence will radically change the present public perceptions, with the public wanting zero risk and maximum compensation. In this context civil society at large will have to play an increasingly important role.

*Proposals for further discussion and action at international level*

- How to identify the new social mediators and reach consensus and new channels for communication and collaboration
- How to coordinate responses and actions in the international field
- Redefine the communication tools: Internet cannot be the main source and tool for communication.

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# CASE STUDIES

## "Case studies" on Risk Communication Activities

C. del Pozo, E. van Rongen, E. Vogel, and A.Thalmann

This section presents a selection of "case studies" on EMF risk communication developed on behalf of national authorities, non-governmental bodies, and industry, which were discussed during the 2nd Workshop on EMF Risk Communication, in Stresa, 2-4 May 2007. There were four areas of interest and panel discussions during the workshop: *"Information campaigns"* (targeted campaigns, evaluation of public understanding and information needs: surveys, opinion pools, focus groups; leaflets, websites, media reporting, etc), *"Education projects"* (education campaigns or initiatives addressed to schools, medical doctors; audiovisual materials, educative leaflets, booklets, etc), *"Participation programmes"* (participatory and 'voting' approaches, public consultation, stakeholder panels, establishing official or independent advisory committees, hearings, etc), and *"Measurement campaigns"* (monitoring of EMF levels in response to public concerns, measurements to address opposition to antennas and masts; communicate emission levels from handsets, ad-hoc surveys, websites, etc).

**Introduction**

Assessing the health risks and environmental impacts of EMF fields is essential for the protection of public health and is a basic undertaking of competent national and international organisations. Another equally important task is to address public concerns and to promote the safe use of the EMF technologies by the provision of up-to-date, readily understandable evidence-based information, and through the development of well-adapted communication tools.

EU member states, Switzerland, and other countries in Europe have developed various initiatives to inform and educate the public on matters of EMF and related public health and safety issues. Primarily such information initiatives are the responsibility of governmental or publicly funded institutions: Ministries, agencies, independent research institutes, or environmental and health institutes. In the majority of cases the purpose is to provide evidence-based information and advice in answer to public concerns, as well as information about new developments in communication and wireless technologies. Moreover, as part of the overall governance system, the practical compliance with the legal requirements by the telecommunication and electricity providers also implies the provision of reliable information on EMF. Of course other stakeholders do also play an active role in what they see as their communication responsibilities.

Examples of valuable initiatives from the authorities, non-governmental institutions and associations across Europe, aiming at informing and educating the public at large, are the implementation of dedicated websites, and the provision of a wide range of information and advice, together with printed material (publications, reports, fact sheets, leaflets, etc), conferences and media events. This also includes the launching of specific education and training campaigns. Some initiatives and information material have been aimed at

legislators or risk communicators in central or local government, and others to health professionals, schoolteachers, and the general public.

These initiatives are generally associated with measurement programmes to assess the exposure of the general population to RF sources (mobile communication base stations, radio, television broadcasting, etc). Exposure assessments are carried-out by national institutions or other nationally recognized independent institutions. The aim of these programs is primarily to verify the compliance with recommended exposure limits for both legal and safety reasons, but they are indeed very important tools to inform the public about the actual levels of exposure to the different RF sources. Most countries also acknowledge some particular concerns of people living in the vicinity of installations emitting EMF and perform on demand, measurements in so-called “sensitive places” (schools, hospitals, etc) and in private homes or offices.

Common ways of presenting the results of measurement campaigns are websites and interactive databases on the Internet, accessible to the public. Therein measurements are often displayed in geographical information systems (GIS), with graphical interfaces, and complemented with descriptions of the methods of measurements and subsidiary information on telecommunication technology as well as health and safety issues.

Another type of risk communication initiative concerns the participation of stakeholders in the decision-making on EMF issues. The basis for this participation must be the transparent exchange of information and the commitment by all parties to engage in a dialogue open to each other’s arguments. Under these conditions, public involvement could help to gain mutual trust, which is essential for good communication. A number of EU countries have implemented such participation programmes to give the public a say in the choice of sites for mobile phone antennas. Participating stakeholders may include immediate neighbours, local authorities, health services, network providers and interest groups. Some national initiatives are worth considering be adopted or adapted more broadly. The limited number of experiences applying different participation “formats” does not, however, permit the definition of a best practice.

**Case Studies**

The “case studies” considered are risk communication studies as such, as well as reported initiatives, approaches, and actions that had clearly identified purposes and objectives in answer to specific questions and concerns. The main elements in EMF risk communication are information and education programmes and campaigns. Additionally, measurement campaigns to demonstrate compliance with regulations and public safety requirements, as well as measurements around single sites, are also considered to be valuable risk communication initiatives. Public participation, on the other hand, which would rather be part of the regulatory process, may nevertheless greatly help the communication process.

*Information*

This first section includes two brief reports, one by Paolo Vecchia of the Department of Technology and Health, National Institute of Health, Rome, Italy (“Information Campaigns: Introductory notes”), and the other by Tom McManus consultant at the Health and Safety Authority, Dublin, Ireland (“A New Approach to EMF Risk Communication in Ireland”). Four other contributions follow, the first one “Spanish experience about risk communication: From theory to practice” by Francisco Vargas Marcos, on behalf of the

Advisory Scientific Committee on radio frequencies and Health (CCARS), Spain; the second one is the paper, "Information and communication on the electromagnetic fields: analysis and differences in the national and international *Internet* sites" by Claudia Giliberti, Angelico Bedini, both at the ISPESL – National Institute for Occupational Safety and Prevention, Rome, Italy, and Silvana Salerno of ENEA, Roma, Italy. The third one is the report, "Representation of mobile phone-related studies in the FEMU EMF-Portal" by S. Driessen, D. Dechent, A. Schmidt, R. Wienert, F. Klubertz, and J. Silny, all at the RWTH Aachen University, University Hospital Aachen, Research Center for Bioelectromagnetic Interaction, Aachen, Germany; and the fourth one is the paper, "Communicating on EMF with political audiences – the UK experience" by Michael Dolan, Stuart Eke, Nicola Davies, and Genevieve Dolan, all at the Mobile Operators Association, London, United Kingdom.

*Education*

In this section we present four selected papers: The first one, "Mobile Communication and Children: A Risk Communication Challenge" by N. Leitgeb of the Institute of Clinical Engineering, Graz University of Technology in Graz, Austria; the second one, "Bavarian School Project with SAR-Measurement Heads" by H. Eder of the Bavarian Environment Agency, and E. Vogel of the Bavarian Ministry of the Environment, Public Health and Consumer Protection both in Munich, Germany. The third paper, "With educational projects to better evidence based politics and more self-responsibility" by Mirjana Moser and Salome Ryf, both at the Federal Office of Public Health, in Bern, Switzerland; and the fourth paper, "Advanced Training for Physicians: Mobile Communication and Health Certified Advanced Training Series for Physicians, Psychologists and Public Health Service Employees" by Dagmar Wiebusch and Fritz Lauer both at IZMF (Informationszentrum Mobilfunk e.V.), Germany.

*Measurement*

Four contributions are included in this section: The first one, "Management of the social and environmental impact of Electromagnetic Fields in Italy" by Mario Frullone and Doriana Guiducci, both at the Fondazione Ugo Bordoni, in Roma, Italy; the second one, "RF Exposure measurement campaigns - Between pure facts and practical risk communication" by Christian Bornkessel of IMST GmbH, Germany. The third one is the report, "The monIT Project: Electromagnetic Fields Monitoring in Portugal" by Carla Oliveira, Daniel Sebastião, Diana Ladeira, Luís M. Correia, all at the Instituto de Telecomunicações, Technical University of Lisbon, Portugal; and the fourth one the brief report, "Measurement and Information Series: Confidence by evidence - TÜV and IZMF Examine Mobile Telecommunications" by Dagmar Wiebusch and Fritz Lauer both at IZMF (Informationszentrum Mobilfunk e.V.), Germany.

*Participation*

This section also includes four contributions: The first one is the report, "Transparency Forum - A Risk Communication Project in Sweden" by L. Mjönes and Lena Hyrke both at the Swedish Radiation Protection Authority in Stockholm; the second one the brief report, "The Bavarian Mobile Phone Pact" by Evi Vogel of the Bavarian Ministry for the Environment, Public Health and Consumer Protection, in Munich, Germany. The third contribution is also a report, "The Dutch model: Public participation in the Installation of mobile Phone Towers" by Rogier Brink of the Antenna Bureau, Netherlands Radio

Communications Agency, and Anke Stapels and Ginevra Delfini from the Ministry of Housing, Spatial Planning and the Environment, The Netherlands. The fourth one is the paper, "Public participation in technology evaluation and risk communication" by Horst-Dietrich Elvers and Christof Tannert, both at the Unit Bioethics and Science Communication, Max-Delbrueck-Center for Molecular Medicine in Berlin, Germany.

**Concluding remarks**

There is no common approach to EMF risk communication that will satisfy all stakeholders. This makes the position of responsible authorities even more challenging when protecting the health of the public, and responding at the same time to public demands for more information, education, measurement and participation concerning these matters. Essential evidence-based information and best practice advice is provided by National scientific institutes, the WHO, and other competent international scientific institutions. The greatest difficulty, however, is that often the majority of the public does not take part in the communication process. So letting aside some highly motivated concerned citizens and action groups, which usually have their own made up opinions, we are left with an apparently silent majority.

People generally start worrying about EMF technologies and possible environmental and health impacts when something happens in their immediate surroundings, e.g. plans for putting up a base station or power line. Then they start gathering information and are usually quickly confronted with negative information about possible health threats, sometimes including alarming reports in the media. It is therefore important to provide people with the right information at the right time.

A crucial trend in our society is the urge for fast and simple responses. Modern media fulfils this demand readily and, thereby, sometimes biased or anecdotic risk understanding is amplified, misrepresenting or even disregarding sound scientific evidence. Despite examples of controversy driven by the interaction between some media and a small number of activists, controversy is an unavoidable – and often necessary – part of our democratic process. The intelligence and concerns of the public must never be underestimated, and the need for readily accessible, understandable, and accurate information, must be recognized and addressed.

Ideally, risk communication activities should be planned well in advance, must have clear aims and follow a defined protocol, and their development and success be monitored. Only under such conditions their output can be evaluated and may lead to worthwhile recommendations and actions. Having this perspective in mind, a number of remarks and recommendations summarizing the main topics debated during the panel discussions can be made:

- Early planning when communicating about possible risks is advised. It can be done by including risk perception studies to identify, understand, and better respond to public concerns over EMF. Only then risk information will be more accurately targeted to the public needs. Especially, crisis-management programs must be developed and perfected in advance. Once there is a crisis, it is virtually impossible to conduct an effective communication campaign.

- The credibility of the information is improved when it actively involves trusted third parties. Recognised independent experts or representatives from reputable competent institutions might be entrusted to present the scientific consensus rather than personal opinions.

- Information campaigns to foster the public knowledge and understanding of the possible risks and benefits of electromagnetic fields (by providing brochures, leaflets, FAQs, etc), although perceived as "one-way" communication initiatives, information campaigns are the necessary precursors to effective dialogues.

- According to some case studies the impact of information on the public understanding of EMF technologies and their health related issues is unclear. Apparently large, widespread information campaigns may have no effect at all. Two reasons could be advanced to explain this failure: one is that specific individual concerns are not being addressed, the other is that once people have developed an opinion it is highly unlikely they will change their minds in the light of new information or facts. To overcome such limitations a careful planning is essential, identifying people's concerns before hand, and providing up-to-date, readily understandable information.

- Although the input of scientific arguments is highly important, policy makers, experts, and industry should also be open to value-based arguments from the general public. After careful consideration of all, appropriately weighted arguments, in the end however decisions will have to be based on the best available scientific evidence.

- Risk education, e.g. in the form of training courses for medical professionals or schools, is directed to specific groups and therefore needs to be tailored to their particular needs. The training of medical professionals is of particular importance because they enjoy the public trust, and are usually the first contacted with people's questions on health-related matters. School projects, in the other hand, are a good opportunity to promote science and technology literacy in a larger and deeper basis.

- Participation processes involving the public in the siting of mobile phone masts can be important for gaining trust. The stakeholders involved in the participation processes, e.g. the industry, authorities or the public, have interests that do not necessarily coincide. However, an open and transparent process may help to reach a general agreement.

- Participation will not necessarily lead to consensus but it may reduce tension and improve the general climate for debate. It might help to establish a platform for exchanging different views. Even a one-way dialog is considered better than no dialog at all.

- The arguments of all representative participants should be heard. Their further involvement should only be conditioned to their commitment to an open dialog and the willingness to clearly put forward their arguments and concerns.

- Measuring the emission levels from phone masts and other RF sources, and informing the general public to demonstrate that exposure is indeed below the ICNIRP limits, is generally considered to be a good risk communication practice. Open access to on-line databases has been implemented in many EU countries, taking advantage of the measurements and assessments carried-out by the competent authorities and the network providers to enforce and monitor "compliance" with current regulations.

- Measurements taken in selected locations can provide the opportunity for trust building due to personal contact and discussions. Therefore, a measurement campaign is half exposure assessment and half a risk communication exercise. Consequently it is important to combine measurement campaigns with information campaigns.

As an overall remark, the paradoxical effects of precautionary measures should be acknowledged. Although their original intention is to deal with scientific uncertainty with regard to the existence of any risk and its possible adverse health effects, studies show that precautionary advice may be interpreted by the public as a signal of the existence of adverse effects. Therefore precautionary measures must be the result of a broad consensus when reasonable doubts of possible harm are supported by sound scientific arguments.

Trust is essential for good communication. It is a key, if not the key factor. If the recipient does not trust the messenger a dialog is not possible. If there is no trust, any risk communication is due to fail. This workshop has shown that there are a number of possibilities to gain or increase trust. With that it provides a valuable tool for future risk communication efforts.

# Information

## Information Campaigns. Introductory Notes

Paolo Vecchia
Department of Technology and Health, National Institute of Health, Rome, Italy.

Actions aimed at informing the public about characteristics, sources and risks of electromagnetic fields have been carried out by a number of authorities, agencies and scientific institutions worldwide. Different strategies have been adopted, and different tools have been used. A broad distinction can however be done between what could be called “information actions” and “information campaigns”.

Information actions consist in the single, one-way provision of information by experts through various channels including newspapers, leaflets and booklets, radio/TV reportages and talk shows, videos and CDs, and Internet. Such actions can be local or nationwide, and are often widely publicized. Their limitations however are obvious. They are occasional and – with the possible exception of Internet – short-lived, so that the effect fades quite rapidly; the number of recipients is unpredictable and, most important the impact on the public is not verifiable given the lack of any feedback.

Communication campaigns, on the other side, are coordinated actions, planned in advance and developing over the time. A campaign may just consist of a series of unidirectional actions of the type discussed above, possibly through different channels; however, it has been noted that a direct dialogue between experts and citizens, with a two-way flow of information is more useful. Several experts and institutions, including the World Health Organization (WHO), have recommended such approach.

In principle, an information campaign is articulated in a number of steps that include preliminary planning, definition of a protocol, evaluation of results, and possibly a final report. Dialog-based campaigns allow a continuous feedback, with the possibility to evaluate at the moment the effectiveness of actions taken, and to refine strategies and messages as needed. The main limitation is that they are expensive, and generally limited to local areas.

Actions and campaigns have been carried out virtually in every country, with a marked increase in the last years. Such increase is largely due to the rapid development of mobile telephony and the associated spreading of antennas that has created much concern in many groups of the population. The number of actions is almost uncountable, and much could be learnt by the experience gained with them. Unfortunately, however, while the messages are most often diffused through the web, and therefore accessible worldwide, virtually no details are provided by the promoting agencies on the communication strategies that they have adopted. Little or nothing is available on the motivations of the action, the target population and how it was selected, the protocol and, most important, the final impact on the public, i.e. the effectiveness of the action. To further limit diffusion of information, most of the material is only available in the local language.

It is unfortunate that such lack of reporting and evaluation prevents the use of past experience as a guidance to improve future communication strategies. Given the

impossibility of a comprehensive overview of information campaigns worldwide, three examples of actions carried out in Italy are presented as case studies.

In 2003, a booklet on mobile phones and health was attached as a supplement to an important Italian newspaper, with a circulation of about 330,000. No evident immediate impact could be observed, and no effort was made for its evaluation. Some hint could however be gained because the councils of four large Italian cities decide to organize public discussions on mobile telephony using the booklet as firing document. During the meetings, held some months after the publication, it clearly emerged was the large majority of the participants were not aware of the very existence of the booklet, while the few who had read it had forgotten the content or had not been much influenced by it.

In the city of Genoa (about 600,000 inhabitants), an agreement was signed some years ago between different stakeholders (City Council, University of Genoa, Regional Agency for Environmental Protection, operators and groups of citizens) on the installation of base stations for mobile telephony. The agreement aimed at "ensuring health protection and providing correct information to the public on the issue [of mobile phones]". A protocol was jointly defined for an information campaign whose steps included the publication of a booklet to be distributed to all families, a series of seminars held in each city district, and a series of TV talk shows at each local broadcaster. In parallel, an extensive monitoring of environmental fields in the city area was carried out, and the results were made available for public debate. All stakeholders expressed satisfaction for the outcome of the campaign, but a number of questions remain unsolved.

No objective evaluation of the outcome apparently exists. The success has been claimed based on rough indicators, such as a decrease of litigations, appeals to court, and requests for a monitoring measurements of electromagnetic field levels around the antennas. Such empirical evidence might however be biased, because a general - though slow – trend for a decrease of public concern has been observed in the last years all over the country. A comparison with other cities where no similar campaign has been carried out might reduce the possibility of bias, but there is no evidence that such a comparison has been made.

Another open question is how long the impact of the campaign can last. The campaign in Genoa was completed in 2001, and there is no objective way to establish to what extent the present attitude of the population still depends on that action. On this regard, it should be noted that the groups of population that are involved change over time. People are especially sensitive to those specific risks to which they are exposed at the moment, and it is likely that persons that are concerned today about antennas close to their homes were not interested in the issue when the campaign was in progress if the antennas were not yet installed at that time.

A final question regards costs. Given the wide scope of the campaign, the multiplicity of activities, and the number of subjects involved, the initiative must have been very expensive and time consuming (by the way, is also regrettable that such data are also not available). Where the initiative can be seen as a reference model, it seems not practical to replicate it systematically in other cities.

The so-called "Blubus campaign" was planned and performed by the Ugo Bordoni Foundation, a technical institution tightly linked with the Italian Ministry of

Communications. In 2003-2005, a bus specially equipped with monitoring stations, electromagnetic field meters and a set of audiovisual tools travelled throughout the Country and stopped for one or days in about 130 towns. In collaboration with local authorities, interactive meetings with the local population were organized, where a team of experts provided lectures, distributed written material and answered questions from the public. At the same time, a technical staff was available for actual measurements of environmental electromagnetic fields, with the active participation of citizens who could personally verify the exposure levels and make comparisons between base stations and other antennas.

If evaluated based on the participation and interest of local citizens, the campaign was very successful. However, questions similar to those discussed above for the experience in Genoa also arise in this case. It should also be noted that, although the bus intentionally reached all the Italian regions, the campaign cannot be defined as nation-wide, but was rather a collection of local meetings, whose impact did in general not extend behind the borders of the town.

In conclusion, any campaign and information action has strengths and limitations, in part unavoidable. Margins for refinement however exist, and it seems important that occasions are create for exchange and discussion of mutual experiences.

## A New Approach to EMF Risk Communication in Ireland

Tom McManus
Health and Safety Authority, Dublin, Ireland

The "New Approach" in the title of this presentation is perhaps a little misleading. It is more relevant specifically to Ireland than to the world at large. However Ireland has played a unique role in EMF technology, particularly in the development of wireless telecommunications, that I thought I'd begin with some history.

Let me show you something.

This is a bottle of Irish whiskey. It might surprise you to know that without this particular whiskey we might not be meeting here today. Although it would still be probable that the younger among you could be holding this or a similar meeting sometime later this century.

You see Anne Jameson, was Irish and from this same whiskey family, and she was the mother of Marconi. The famous Guglielmo Marconi who was the Bill Gates of his day, the youngest ever winner of a Nobel Prize, and the technical and commercial genius whose contribution to wireless telecommunications revolutionised our world. However it was by Jameson money and through his mother's connections that Marconi in 1896, at the age of twenty-two, filed the world's first patent on wireless telegraphy.

Marconi's father was not enthused by his son's wireless experiments: *'perdita completa di tempo*[1]*'* was his opinion. Fortunately the Jameson family and a number of Irish grain merchants had more faith and provided the £100,000 capital (E10 million in today's money) to set up the Marconi Wireless Telegraph Company in 1897.

There quickly followed many technical and commercial firsts that hinged on Ireland's strategic geographical position. Shipping from North America to Europe had to go round it! It was important to know when and what ships were arriving. Systems using semaphores, lamps and even floating waterproof containers were being employed. In 1898 Lloyds of London signed the world's first commercial radio contract with Marconi to report shipping movements around the northeast coast of Ireland at Rathlin Island. Three years later, on behalf of the Reuter news agency Marconi set up a similar facility to report shipping movements around Fastnet Rock in the extreme southwest of Ireland.

In1905 Marconi set up the first transatlantic radio link. This was based at Clifden near Galway and communicated with Cape Race in Newfoundland. A regular commercial service began in October 1907. The first message was from the UK Minister of Trade, David Lloyd George, to his opposite number in Canada. The second message happened to be the first use of radio for political ends. The Chairman of Galway County Council sent greetings to the American president, Theodore Roosevelt, and asked for his assistance in obtaining Home Rule for Ireland!

Ireland's enthusiasm for radio and of its potential to serve political ends was illustrated a few years later in 1916 at the time of a seminal event in Irish history referred to as the

[1] "a complete waste of time"

Easter Rising. The Irish rebels or patriots, depending on your point of view, took a ship's wireless into the General Post Office building in Dublin and used it not to send a point-to-point message, but to make a diffused broadcast in the hope of getting word to some ships so that their story would be relayed to the American press. And in this endeavour, they succeeded. It was the first radio broadcast in Europe!

Over the next seventy years Ireland's involvement with electricity and radio was one of the public demanding and the government providing. Mains electricity for the whole country was completed in the 1970s. A second national television channel with colour was introduced and discussions were underway to permit broadcasts by independent and not just state-owned radio stations. Meanwhile, strangers arriving in Dublin by train would be amazed by the number of 20 – 30 metre high TV antennas attached to every chimney in sight. In the absence of cable – a distant dream – it was the only way to receive UK stations. Then, in 1987, a man called Savitz changed all this.

In 1987 the state electricity utility, ESB, upgraded the final 40km of transmission line to 220kV to complete a high voltage network around the country. But before the line was energised David Savitz submitted his report on childhood cancer in Denver to the New York State Powerlines Project. Recall that the Panel of Scientific Advisers to the project concluded: *"…with the assumption of a causal effect [Savitz' report] would mean that 10-15% of all childhood cancer cases are attributable to magnetic fields."* No government could ignore such a possibility.

As an interim measure the Government put the problem in the hands of the minister responsible for electricity - the Minister for Energy. This interim measure was to last nearly twenty years! We began by delaying energising the line until a report on the problem was completed. That report concluded that there could indeed be a problem. However such a problem was more likely to become first apparent in larger countries that used much more electricity than Ireland. We promised to carefully monitor developments.

Monitoring developments led to a number of ad hoc policies, initiatives and measures that included:

- The informal adoption of the ICNIRP guidelines.
- Using the WHO and its publications as our main source of scientific information and supporting the WHO International EMF Project from its start in 1996.
- The preparation of regularly updated standard letters dealing with power lines, sub-stations, phone masts and mobile phones.
- Handling information requests received by telephone.
- Co-ordinating the responses of government ministers to parliamentary questions on EMF to ensure a consistent policy line was maintained.
- Participating in EU COST initiatives and the UKCCS project.
- Sponsoring a number of major international EMF conferences in Dublin.

Among some of the more original risk communication initiatives we adopted were:

- Free EMF surveys of homes near power lines and electrical sub-stations.
- A detailed on-line map showing location and size of every phone mast.
- Organising annual meetings with the electrically hypersensitive groups.

The Irish Parliament has, like many other parliaments, standing parliamentary committees. In 2005 the Joint Oireachtas Committee on Communications took a long overdue look at the EMF and health issue and concluded that some new permanent arrangements should be put in place. An Inter-Departmental Committee of senior civil servants was set up to prepare a report and make recommendations to the Minister for Communications, Marine and Natural Resources who includes the energy remit in his portfolio. The Inter-Departmental Committee commissioned an Expert Report to provide scientific background on EMF, respond to the most frequently asked questions on EMF and, in consultation with the Committee, to make recommendations on the form the desired new arrangements might take.

The result was a report[2]. The main contributors were Mike Repacholi and Eric van Rongen. We also had invaluable comment and suggestions from a peer review group comprising Anders Ahlbom, Carmela Marino, Alastair McKinlay and Berndt Stenberg. I shall not summarise those parts of the report dealing with the review of the science and the responses to frequently asked questions. Paper copies of the report are available here and an electronic version can be downloaded at www.dcmnr.gov.ie.

I shall confine myself to the proposals for the new arrangements now being implemented in Ireland in the light of the Government, on March 31st 2007, accepting the report and adopting its recommendations:

- Responsibility for non-ionising radiation moves to an existing agency of our Department of the Environment - the Radiological Protection Institute of Ireland (RPII).
- Responsibility is to include IR, visible light, UV, lasers and ultrasound.
- The RPII will provide advice to Government and public bodies; information to the general public; monitor public exposure; undertake and manage research on EMF health and safety issues.
- A Scientific Advisory Committee is to be set up to advise RPII on scientific developments in EMF.
- An EMF Safety Users Group to represent stakeholders will be formed and meet RPII and the Scientific Advisory Committee from time to time.
- A Policy Co-ordination Committee on the Health Effects of EMF (similar to the Inter- Departmental Committee) will represent the relevant government departments and agencies and be overseen by the Department of the Environment.

On May 1st responsibility for EMF was transferred from the Department of Communications, Marine and Natural Resources to the Department of the Environment, Heritage and Local Government. The interim arrangements were at an end!

ote: The author is indebted to information contained in the publication: “Marconi – The Irish Connection” by Michael Sexton, Four Courts Press, Dublin 8. (2005).

[2] *Health Effects of Electromagnetic Fields*, Department of Communications, Marine and Natural Resources, Leeson Lane, Dublin 2, Ireland (available for downloading at www.dcmnr.gov.ie).

## Spanish Experience About Risk Communication: From Theory to Practice

Francisco Vargas Marcos
On behalf of the Advisory Scientific Committee on radio frequencies and Health (CCARS), Spain

**Abstract:**
This document presents the Spanish experience on Radio Frequencies (RF) and Health since the introduction of mobile phone. It describes the problems associated with the current status of science and how we can improve our capacity to communicate the results of scientific studies. We mention the most relevant studies and national reports giving an overview of current evidence on possible health impacts, and discuss how the deployment of base stations in Spain have been carried out. We also mention the legislative initiatives and other relevant actions in the field of RF & Health. We describe the main problems related in the Spanish context, with risk communication, claims on "cancer cluster" and risk perception. Finally, in our opinion risk management could be greatly improved by both the provision of information based on sound scientific evidence and by taking into consideration the social, economic, and political aspects of risks communication.

### Introduction

Radio frequency electromagnetic fields (RF-EMF) are the object of social controversy often fed by less than rigorous pieces of information that generally disregard scientific argument as well as evidence. *How can citizens be informed of the current status of the science in an accurate and objective way?*

Scientists may keep track of the state of the science through "Science Citation Index" (SCI) journals. SCI lists articles from scientific journals classified according to their impact index, measured as from the number of times an article has been cited (it can be found at http://www.thomson.com/). For the general public, however, who do not know the specialised language used by the different disciplines, there is no alternative but to turn to independent prestigious institutions. Among these institutions we may mention the Science Academies of the most developed countries in the field of science, the great National Research Centres such as the Spanish National Research Council (*Consejo Superior de Investigaciones Científicas*), the Expert Committees of the European Union, the National Scientific Societies, world renown and accepted Universities, the World Health Organization, etc. The information obtained should be made available to the public in a clear form and with a language easily understandable by the public.

The main issue to be solved is the following: *How can we improve our capacity to communicate the results of scientific studies in a reliable and effective way?*

The need to promote better public understanding of the difference between scientific studies and other studies is urgent. There is no doubt that current risk perception of RF-EMF is overstated if we contrast it with the findings published by world-renowned scientific institutions. We live in a new information society that offers undeniable economic, technological and social advantages. At the same time access to Internet, communication media, TV, radio, free newspapers etc., offers a huge amount of

information that has not been contrasted with, or supported [1] by solid scientific evidence. This information that has not been screened through an appropriate methodology leads sometimes to what has been called *"cyberchondria"***,** a hypochondria "supported" by information from the Internet. During medical practice we may receive patients that request certain tests or analysis in order to discard certain symptoms or diseases they have read about on the Internet. There is an excess of information that has not been evaluated with objective criteria that may cause unnecessary, anticipated and unjustified suffering.

Faced with a scientific question for example, “Are electromagnetic fields dangerous for our health?” science provides answers using the scientific method, based on the analysis of evidence in order to discover the levels and characteristics of the risk for our health. The right answer would evaluate the available pieces of evidence applying strict selection criteria to studies (meta-analysis, well-designed studies, identification of methodological bias, etc). Once this evaluation has been carried out, any sector or individual involved (stakeholders) should be informed for decision taking. Being aware, all that while of the difficulties in interpreting the studies’ results and their subsequent communication to the public in an understandable format.

One of the most accepted methodological tools is the "risk assessment" [2], which offers information to:

- ✓ Evaluate the harmfulness of an agent
- ✓ Characterise and define an acceptable risk level
- ✓ Develop strategies for risk prevention or reduction

**Scientific evidence**

The application of this methodology has involved the review and study of the effects derived from exposure to electromagnetic fields (EMF) within radiofrequency spectrum. All competent national and international organizations such as the Ministry of Health and Consumer Affairs, the World Health Organization, the ICNIRP, the European Union, the American Environmental Protection Agency, the CDCs, etc. agree in stating that there are no adverse effects for the health derived from exposure to radiofrequencies from mobile telephone base-stations.

The is a large body of sound evidence about this topic [4,5,6,7], and in particular, research published in several epidemiological articles [3] confirms that: “Results of these studies to date give no consistent or convincing evidence of a causal relation between RF exposure and any adverse health effect”. The are, moreover, a number of published reports from renowned scientific institutions such as WHO [8], ICNIRP, European Union [9], MTHR-HPA (UK) [10], Independent Expert Committee [11, 12] from the Ministry of Health and Consumer Affairs (Spain, 2001) and Scientific Advisory Committee on Radiofrequency and Health from the Universidad Complutense de Madrid (Spain. 2005-2007), Report from the Ministry of Health and Consumer Affairs [13] (Implementation RD1066/2001,2005), SSI´s Independent Group [14] on electromagnetic Fields (Sweden, 2007:04), Irish report on Health Effects of EMF (2007) [15], Health Council of the Netherlands (2007) [16], etc.). In this last report from the Netherlands it is concluded that there is no evidence of harmful effects for the health derived from exposure to UMTS and DECT.

Sometimes, some self-designated experts express opinions lacking a sound scientific basis. However, their point of view is accepted by the communication media without analysing whether their results have been obtained applying the scientific method or not. Well-performed scientific studies are compared and equalled to others that do not stand the least methodological examination. The final risk perception by the general public can be of uncertainty or disagreement between "experts" when the truth is that there is an overwhelming amount of scientific evidence, at least nowadays, establishing that:

> *"Expert reports conclude that it cannot be stated that exposure to electromagnetic fields within the limits set by the ICNIRP-WHO (WHO) may produce adverse effects for human health."*

**"Cluster" of cancer cases**

One of the greatest concerns for population regarding mobile telephones is the appearance of cancer cases attributed, with no scientific basis, to RF exposure. We know that cancer is caused by several factors. We know numerous risk factors and causative factors. Age, genetic susceptibility, the immune system, exposure to physical-chemical carcinogens, diets, smoking, drinking alcohol and other factors are directly related to cancer ethiology. If we examine official statistics on cancer prevalence, incidence and mortality in a determined geographic area we shall verify that it agrees with the number of cases expected for such population. As we get older the probability of suffering cancer increases. This epidemiological pattern is repeated in most developed countries where cancer and strokes are the main cause of death. It is clear that the longer the life expectancy the highest the probability of suffering cancer.

For this reason it is convenient to give a timely and clear answer when we face a cluster of cancer cases [17]. Facilitating appropriate information and a review of available epidemiological data may discard the appearance of a cluster and may reassure the affected population [18]. In these situations, the detection of the case that triggered social alarm, turns risk factors located nearby, in this case an antenna or a base station, into something threatening, attributing the cause of the disease to its presence.

There is evidence from numberless published articles regarding the absence of any effect derived from exposure to RF from antennas. On the face of such evidence, the interest has shifted to the possible association between brain tumours, especially acoustic neurinoma, with the use of terminals. A recent epidemiological study [19], with a cohort of 420,095 telephone users concludes that: "we found no evidence of any association between tumour risk and cellular telephone users neither among short-term nor among long-term users." These results are reassuring even though it is logical that the long-term effects be still under investigation due to the short exposure time and the long latency period of tumours. However, all seems to indicate that there is no association between telephone use and brain tumours. Therefore, Hill's causative criterion has not been met and no plausible biological mechanism has been proven.

**The Spanish experience**

When the initial deployment of base stations in Spain started, about 1995, there were no laws to regulate installation requirements taking into account the point of view of exposure to radio electric emissions. This failure, shared at global level, could be used as an argument to oppose to their installation. Spain ratified in 1999 the EU Health Council

Recommendation (1999) limiting the public exposure to electromagnetic fields (0 Hz 300GHz), being as from publication the standard reference for all installations. The Ministry of Health and Consumer Affairs accepted the recommendations of an Independent Expert Group [11], which proposed to establish as mandatory the exposure limits of the ICNIRP and the European Recommendation. In this way, Royal Decree 1066/2001 regulating conditions to authorize and control radio electric emissions throughout the country, restrictions to radio electric emissions and protection measures against radio electric emissions was published.

In a very decentralised country having three levels of political decision taking (state, regional and local) this Royal Decree had a global positive impact even [20] though some Regional Communities adopted limits of their own based on non-scientific criteria based on an incorrect application of the precaution principle. The current situation is that there are several laws regulating different aspects related to telephony. At the same time, municipalities suffering the pressure of public opinion approved local ordinances preventing the installation of base stations in urban centres or with severe restrictions as regards distances with the consequent difficulty to render a high quality service with the best service guarantees. The criteria used by Municipalities were not only urban but also related to health and environment.

In the face of social alarm, similar to that of other countries [21] the concern regarding RF effects is an issue for political debate and it is used as a tool for political mobilization, everybody has an opinion about it and Internet is the source “supporting“ un-contrasted opinions of individuals opposed to antennas. In this situation, communication media place at the same level the opinions of accredited experts with those of laymen, with the argument of guaranteeing impartiality and respect for all opinions. The final result is that the general public "perceives" controversy amongst scientists, increasing unnecessary confusion and alarm.

It is odd and amazing that Spain is the country having more measures regarding emissions (in 2002 it measured emissions and certified all the network and annual measurements are performed from that moment on) wherein the observed limits are a hundred or a thousand times below the statutory limits established by law (RD 1066/2001 ICNIRP-WHO, EU) and wherein the continuous requirement of new measurements is still in force. The access to information on measurements performed in all national territory is public, free and accessible and nevertheless the installation of base stations is still rejected.

There are several initiatives made by some of the involved entities. The Ministry of Industry, as competent authority in telecommunications, promoted the creation of the Scientific Advisory Committee on Radiofrequency and Health of the Universidad Complutense (CCARS), this Committee give scientific advise on different aspects related with RF and health [22]. The Association of Telecommunication Engineers (COIT) or the Service of Technical Advisors of the Spanish Federation of Municipalities and Provinces (SATI-FEMP), carry out activities regarding information and assessment on health, legal and technical aspects on mobile telephone operation and RFs.

**Risk perception**

Some people consider it possible that RF exposure entails risks that may even be serious. This concern is caused, among other things, by news published by communication media

on recent and unconfirmed scientific studies that create a feeling of lack of safety and a sense that there may be hidden or unknown risks. Other factors are the aesthetic nuisances and the feeling of lack of control and participation in decision taking regarding new base stations location. The experience shows that educational programmes, as well as an effective communication and public and other stakeholders' participation in the proper phases of the decision taking process prior to the installation of sources of RF may increase public trust and acceptance.

It is clear that risk perception for scientists is not the same as for citizens. The factors accounting for these differences have been analysed by the WHO in the document titled "Establishing a dialogue on risk from electromagnetic fields". Scientists' perception is more probabilistic, and is more based on the scientific method. Laymen are led by their beliefs or self-comforting opinions; they want a clear answer, a "yes or no" and do not accept involuntary exposition. It is a paradox that those opposed to the installation of antennas are using mobile phones that obviously cannot operate if there is not a good base station network. Both perceptions must be respected and people in charge of risk management must choose the best options based on mutual respect.

**Are EMFs safe?**

This is the question that scientists must answer to journalists or citizens. The best we can achieve in an experiment or epidemiological analysis is that, within specified statistic probability limits, the risk entailed by a drug, a new form of radiation or any other agent does not exceed a specified amount, for example, one in a million. From the point of view of public health, it is interesting to know the total dose of radiation received, voluntarily and involuntarily and the percentage attributed to each emission source (TV, radio, telephones, electrical appliances, high-voltage transmission lines, natural emissions, emergencies and police communication systems, etc).

We must not fall in the illusion of pursuing absolute safety; there is no such thing as zero risk [23]. We take decisions everyday that entail risks, but we assume them anyhow. Is gas safe? Of course not, but the value added to our life quality is such that population is ready to accept and live with such a risk. It is convenient to bear in mind this simile to evaluate the meaning of the studies performed in this area, with all due precautions.

**How can we give an effective answer to a distorted risk perception?**

An excessive amount of regulations has contributed to increase confusion over RF effects. In Spain, one of the most important solutions is a proposal of a common regulation agreed upon by the Spanish Federation of Municipalities, the operating companies, the political parties, competent authorities, neighbour associations and all those stakeholders interested in achieving a definitive solution to the deployment of base stations.

Fear is a contagious disease; just remember the media crisis [24] caused by Bovine Spongiform Encephalitis in 2000-2001, by dioxin contamination in 1999, by legionella outbreaks, etc. The only demonstrated consequence is that the use of mobile telephones while driving a car increases the risk of suffering accidents [25]. The only demonstrated health risks are related with inattention while driving). Therefore, it is convenient to place the risk in its actual context.

**Final remarks**

The acceptance of a new technology is limited by several factors related with cultural level, age, education, benefits granted, disadvantages, political climate, and other well-known factors [26]. The process of introducing mobile telephones has been rapid, and certain status of our society still need to assimilate the advantages granted by information technologies. There are worries that have to be faced with continuous, clear information. It is understandable to be suspicious of possible interests hidden behind this business; the power of large corporations is feared. Sometimes we forget that the companies are intended to render services but at the same time to create knowledge, jobs, wealth and to meet the legal obligation of offering quality service in terms of telecommunication.

- Faced with the appearance of a conglomerate we must act co-ordinately with all involved parties, explain accurately the measures taken, consider the different perception of the population, ethical and social values involved; in short we must improve citizen participation in problem management.
- It is necessary to clarify beliefs related with chronic exposure, the confusion over cumulative doses and chronic or long-term effects that have not been proven up to date.
- There is an information deficit over EMFs; population needs to receive contrasted information from reliable and strict sources. In this sense, health authorities must assume a higher involvement and responsibility in public information. They must not look the other way. Health personnel should be better informed regarding EMF effects and the so-called "electrosensitivity" [27,28,29]
- It is urgent to solve doubts posed by some neighbours regarding contractual terms to install base stations (safety, costs, maintenance, book value of premises, etc). That would improve trust between companies and the owners or lessees of those buildings where antennas are installed.
- Another aspect creating uneasiness is the perception that children are more susceptible; this idea originates in an English report (IEGMP Mobile phone and health, 2000). The doubts or the lack of evidence led a number of experts to establish sensitive areas that should be the object of more strict surveillance. This idea has generated unjustified concerns, alarms and incorrect application of the precaution principle [30,31].

In the last place, it is to be noted that in order to improve information it is necessary to engage in the debate keeping the following principles:

- ✓ Facilitate information based on strict scientific evidence.
- ✓ The level limits set by ICNIRP-WHO are safe and there is no reason to justify their modification.
- ✓ Show respect for the opinion and feelings of those individuals expressing doubts and fears
- ✓ Be sincere and neutral.
- ✓ Take into account the social, economic and political aspects of risk communication.
- ✓ Improve the knowledge and acceptability of new technology risks. Its advantages and inconvenient.

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# Information and Communication on the Electromagnetic Fields: Analysis and Differences in the National and International *Internet* Sites

C. Giliberti [(1)], A. Bedini [(1)], S. Salerno [(2)]

[(1)] ISPESL, Via Urbana, 167, 00184 Rome, Italy
[(2)] ENEA Casaccia, SP 018, Rome, Italy

## Introduction

On the earth surface, electric, magnetic and electromagnetic fields are naturally produced by cosmic and earth radiation. Artificial radiation systems to generate, transport, and distribute the electric energy, as well as the telecommunication systems, have produced an increase of the electromagnetic field background as regards the natural one. The potential healthy risks, due to long time exposition in the working and living conditions, are discussed in the scientific community and among the public. The physical phenomenon "electromagnetic field" (EMF) is quite complex to analyse because of the variety of the field sources (power lines, radio base stations, etc), their different physical properties (EMF at low frequency, EMF at high frequency) and their different ways of propagation [1,2].

It is very important to investigate the interaction of the EMF with the biological systems, that is the reason why in the last years, many research projects have involved *in vivo*, *in vitro* and epidemiological studies [3,4]. At present, the debate on long-term exposure to the EMF is still open and the consequences on human health still undefined. The variability of the limits related to the EMF frequencies and type of exposition (environmental or working) in the national and international Legislation produces uncertainty [5,6,7,8]. Due to these crucial points, risk perception and communication are difficult to analyse and to manage.

The growing interest and the request for information on the EMF coming from the public, has suggested the idea to analyse the answer supplied by *Internet*. In the last years, the use of the *World Wide Web* is growing (Table 1) [9]. In Europe, 61% of the users recognize *Internet* as a useful up to date tool, while 70% recognize *Internet* as the most efficient source of information. The suitability, the speed and the easy access to *Internet* produce a growing increase of its use (20%) in comparison with reviews (8%), newspapers (11%), showing a percentage close to radio (30%) and television (33%) [10]. In Italy, the *Internet* diffusion is 49%, with an increase in the last 5 years equal to 119%. *Internet* is then a powerful tool for "*information*", "*communication*" and also "*education*" of the public. For this reason, each *Internet* site, with the purpose to inform and educate the public, has to be oriented as a textbook, using links and the interactive properties for the two-ways *communication* among public and experts.

This study has the purpose to evaluate the quality of the "*information*" and "*communication*" on the EMF in the Italian and international *Internet* sites, analysing their differences. Ten specific indicators have been defined and searched in each *Internet* site.

| Regions of the world | Percentage of penetration of the Web | Internet users | Percentage of growth in the use of the *Web*, years 2000-2005 |
|---|---|---|---|
| North America | 68,6 % | 227.303.680 | 110,3 % |
| Oceania and Australia | 52,6 % | 17.872.707 | 134,6 % |
| Europe | 36,1 % | 291.600.898 | 177,5 % |
| Latin America | 14,4 % | 79.962.809 | 342,5 % |
| Asia | 9,9 % | 364.270.713 | 218,7 % |
| Middle East | 9,6 % | 18.203.500 | 454,2 % |
| Africa | 2,6 % | 23.649.000 | 423,9 % |

**Table 1:** Data related to the use of Internet in the world [9].

## Methods

The first study has been carried out applying search engine *GOOGLE*, in the Italian area, using two key words "*campi elettromagnetici*" ("*cem*" that is "electromagnetic fields" (EMF)) and "*campi elettromagnetici e salute*" ("*cem+s*" that is EMF and health). We have then investigated the international *Internet* area, using the English key words "*electromagnetic fields*" ("EMF") - "*emf and health*" ("*emf+h*") and the French key words "*champs électromagnétiques*" ("*chem*") - "*chem et santé*" ("*chem+s*"). The first 100 *Internet* sites provided by *Google* for each key word (number 600) have been collected and analysed. The relative countries have been identified.

Each *Internet* site has been analysed evaluating the occurrence of paragraphs dedicated to specific subjects summarized in 10 main indicators:

Six (1-6) of these have been considered "*information*"(one-way):
(1) *Definition of electric, magnetic and electromagnetic fields*;
(2) *Description of the physical effects of the* EMF (way of propagation and interaction between radiation and biological matter);
(3) *Description of the biological and health effects of the* EMF (acute and possible long-term effects);
(4) *Description of the environmental sources* (power lines, radio base stations, etc);
(5) *Indication of the environmental levels produced by the* EMF *sources*;
(6) *Legislation*;
Three (7,8, 9) indicators have been considered "*communication*" (two-ways):
(7) *Risk perception*;
(8) *Frequently asked questions* (*FAQ*);
(9) *Forum* for discussion;
And one (below) has been considered as "*communication and information*":
(10) *Links* to other sites of interest.

This last one represents an interaction between the user and *Internet* as a hyper textual tool, which is typical of the *World Wide Web* concept. All the *Internet* sites have been classified into 11 main categories:

(1) *Public Research Institutes* (Public Institutes, Universities, Environmental National Agencies);
(2) *Health and Environmental Authorities* (Local Authorities, Regional Environmental Agencies, etc);
(3) *Local Authorities* (Regions, Provinces, Urban districts);
(4) *Associations and no profit Associations* (committees, customer associations, etc);
(5) *Companies and commercial sites*;
(6) *Mass media, magazines and information sites*;
(7) *National Authorities* (specific for each country);
(8) *Scientific Associations*;
(9) *National sites for energy and transports*;
(10) *International Organizations* (*WHO* and European Union);
(11) *Other* (personal, schools and University courses sites, other).

The ten selected indicators have been evaluated for the 11 categories in the two areas (national and international). The statistic significance analysis has been carried out using the $\chi^2$ -test and the *2x2* frequency tables to confirm the main differences for each keyword, each category and each indicator.

## Results

### 1. Internet sites per countries

The results obtained using key words in Italian ("*cem*" *campi elettromagnetici*, "*cem+s*" *campi elettromagnetici e salute*), English ("*emf*" *electromagnetic fields*, "*emf+h*" *electromagnetic field and health*) and French ("*chem*" *champs électromagnétiques,* "*chem+s*" *champs électromagnétiques et santé*) and their correspondent countries are reported in Table 2.

| | **Percentage of the *Internet* sites obtained setting in *Google* the key words "*electromagnetic fields*" and "*electromagnetic fields and health*":** | | | | | |
|---|---|---|---|---|---|---|
| | **in Italian** | | **in English** | | **in French** | |
| **Countries** | **"*cem*"** | **"*cem+s*"** | **"*emf*"** | **"*emf +h*"** | **"*chem*"** | **"*chem+s*"** |
| Italy | 93 | 96 | 5 | 1 | 5 | 0 |
| USA | 1 | 1 | 47 | 45 | 2 | 0 |
| Great Britain | 0 | 0 | 11 | 11 | 1 | 0 |
| France | 0 | 0 | 1 | 1 | 50 | 58 |
| Switzerland | 3 | 1 | 2 | 0 | 10 | 13 |
| Netherland e Scandinavia | 0 | 0 | 6 | 5 | 0 | 0 |
| Australia e New Zealand | 1 | 0 | 3 | 10* | 0 | 0 |
| Canada | 0 | 0 | 2 | 3 | 15 | 12 |
| Germany | 1 | 0 | 2 | 2 | 1 | 1 |
| Belgium | 0 | 0 | 1 | 4 | 8 | 8 |
| International | 1 | 2 | 4 | 4 | 3 | 2 |
| Others | 0 | 0 | 16 | 14 | 5 | 6 |

**Table 2:** Countries of the first 100 Internet sites (n. 100 for each key word). *p<0,05

*Internet* sites with Italian key words belong mainly to Italy, with few exceptions like Switzerland sites (3%) for "*cem*" and International sites (2%) for "*cem+s*". *Internet* sites with English key words belong mainly to the United States of America (47% for "*emf*" and 45% for "*emf+h*"), followed by Great Britain (11% for "*emf*" and "*emf+h*") and Australia (11% for "*emf+h*").

*Internet* sites with French key words belong mainly to France (50% for "*chem*", 58% for "*chem+s*"), followed by Canada (15%, 12%), Switzerland (10%, 13%) and Belgium (8%).
We have analysed the statistical differences of the *Internet* sites obtained for each language, changing the key words ("*cem*"-"*cem+s*"; "*emf*"-"*emf+h*"; "*chem*"-"*chem+s*"). The only statistical significant difference in the research with key words "*emf+h*" is in the case of Australia and New Zealand, showing a particular interest of these countries for the health problems.

**2. Internet sites per categories**

In Table 3, the distribution of the first 100 Italian, English and French *Internet* sites in the 11 categories is reported. "*Companies and commercial sites*" are located in the highest rank for the researches "*cem*", "*emf*" and "*chem*" (respectively 20%, 26%, 28%). Adding the key word "*health*", they show a not statistically significant decrease (to 16%, 21%, 24%), maintaining the highest rank except for the Italian area where the "*Associations and no profit Associations*" are the category leader, showing a significant rise (from 7% to 17%). The latest result highlights the particular attention of this category for the relationship between the *emf* and the *health*. The "*Associations and no profit Associations*" of the French area are also relevant for number of sites in the research (22%).

"*Mass media, magazines and information sites*" show an increase with the key word *health* both in English and French languages, without reaching a statistical significance. "*National Authorities*" show an important rise when we add *health* in the French language.

| | **Percentage of the *Internet* sites obtained with the key words:** | | | | | |
|---|---|---|---|---|---|---|
| | **in Italian** | | **in English** | | **in French** | |
| **Categories** | ***"cem"*** | ***"cem+s"*** | ***"emf"*** | ***"emf +h"*** | ***"chem"*** | ***"chem+s"*** |
| Companies and commercial sites | 20 % | 16 % | 26 % | 21 % | 28 % | 24 % |
| Public Research Institutes | 11 % | 13 % | 24 % | 14 % | 19 % | 16 % |
| Local Authorities | 12 % | 11 % | 0 % | 0 % | 0 % | 0 % |
| Health and Environmental Authorities | 9 % | 6 % | 13 % | 16 % | 9 % | 4 % |
| Associations and no profit Associations | 7 % | 17 %* | 12 % | 16 % | 20 % | 22 % |
| Mass media, magazines and inf. sites | 2 % | 2 % | 7 % | 13 % | 5 % | 8 % |
| National Authorities | 2 % | 2 % | 3 % | 4 % | 3 % | 9 % |
| Scientific Associations | 2 % | 2 % | 2 % | 2 % | 2 % | 2 % |
| National sites for energy and transports | 0 | 0 | 1 % | 0 % | 4 % | 3 % |
| International Organizations | 1 % | 1 % | 2 % | 4 % | 0 % | 3 % |
| Other | 34 % | 30 % | 10 % | 10 % | 10 % | 9 % |

**Table 3:** Internet sites in Italian, English, French (100 each) per category and key word (*p<0,05).

Italy stands out for "*Local Authorities*" due to Regions, Provinces and Urban districts that represent the national organization model. In the same way, "*National sites for energy and transport*" has been found relevant only in the French area.

The important role of "*Public Research Institutes*" is well rendered for all the languages, but adding the key word *health* the number of their sites drops except for the Italian area (from 11% to 13%). The WHO site in all the languages mainly represents the "International Organizations" category.

### 3. Internet sites per indicators

In Figure 1, the 10 indicators obtained in the first 100 Italian, English and French *Internet* sites with the key words "*cem+s*", "*emf+h*", "*chem+s*", are reported.

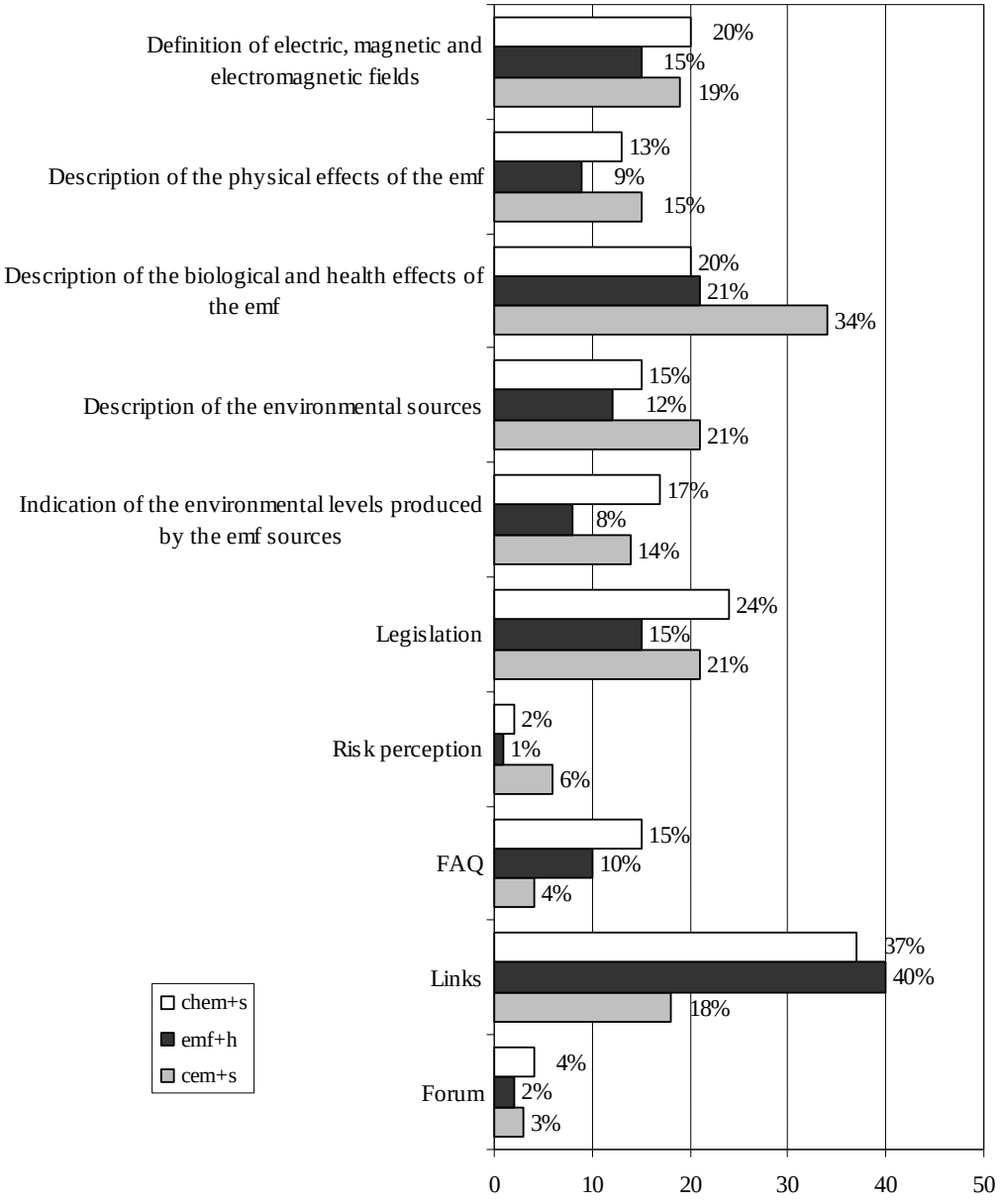


**Figure 1:** Indicators for the 100 Italian, English and French Internet sites using "cem+s","emf+h" and "chem+s" as key research words.

A statistical significance difference, adding the *health* to the key words "*cem*", "*emf*", "*chem*" has been found for "*Description of biological and health effects of the emf*" in the Italian and French area (26% "*cem*"-34% "*cem+s*"; 9% "*chem*"-20% "*chem+s*"), for the "*Links*" in the English and French area (26% "*emf*"-40% "*emf+h*"; 28% "*chem*"-37%"*chem+s*") and for "*Legislation*" in the French area (16% "*chem*"-24% "*chem+s*").

The "*Description of biological and health effects of the emf*" is also the most relevant (34%) in the Italian setting, while "*Links*" show the highest percentages in the other international languages (40% and 37%). "*Forum*" and "*Risk perception*" are in the lower ranks, showing a need for building a dialogue using *Internet*. "*Risk perception*" is more discussed in the Italian area than in the International ones (6% versus 2% and 1%),

although not reaching the statistical significance. None indicator has been found in more than 40% of the sites.

**4. Indicators per categories**

Tables 4, 5 and 6 show the distribution of the 10 indicators in the categories for the researches "*cem+s*", "*emf+h*" and "*chem+s*". In order to identify the most exhaustive categories, an overall score called "*Global Mean Percentage*" (*GMP*) has been introduced. It summarizes only the medium percentage of all the indicators per category. The same results, ordered per indicators, are shown in Tables 7 and 8.

The category "*International Organizations*" is mainly related to the *WHO* site in all the three languages with a *GMP* of 90%, lacking only in the "*Forum*". Those are the reasons why it is not shown in the following tables.

**Categories for the Italian key words "cem+s"**

| Public Research Institutes | Health and Environ. Author. | National Author. | Companies Commercial sites | Ass. - Ass. no profit | Scientific Ass. | Local Author. |
|---|---|---|---|---|---|---|
| **3** (61,5%) | 3 **(66,7%)** | 3 **(50,0%)** | 3 **(31,3%)** | **3** (29,4%) | 2 **(50,0%)** | **3** (45,5%) |
| 2 **(46,2%)** | **1** (66,7%) | 7 **(50,0%)** | 6 **(31,3%)** | 6 **(23,5%)** | 3 **(50,0%)** | **2** (27,3%) |
| **9** (46,2%) | **4** (66,7%) | 1 **(0,0%)** | 4 **(25,0%)** | **9** (23,5%) | 4 **(50,0%)** | **1** (18,2%) |
| **1** (38,5%) | **5** (66,7%) | 2 **(0,0%)** | 9 **(12,5%)** | **1** (17,6%) | 5 **(50,0%)** | **4** (18,2%) |
| **4** (38,5%) | **6** (50,0%) | 4 **(0,0%)** | 1 **(6,3%)** | **4** (17,6%) | 9 **(0,0%)** | 9 **(18,2%)** |
| **6** (30,8%) | **8** (33,3%) | 5 **(0,0%)** | 5 **(6,3%)** | **5** (17,6%) | 1 **(0,0%)** | **5** (9,1%) |
| **5** (7,7%) | **7** (16,7%) | 6 **(0,0%)** | 7 **(6,3%)** | **2** (11,8%) | 6 **(0,0%)** | **6** (9,1%) |
| **8** (7,7%) | **9** (16,7%) | 8 **(0,0%)** | 2 **(0,0%)** | **7** (5,9%) | 7 **(0,0%)** | **7** (9,1%) |
| **7** (0%) | **10** (16,7%) | 9 **(0,0%)** | 8 **(0,0%)** | **8** (5,9%) | 8 **(0,0%)** | **8** (9,1%) |
| **10** (0,0%) | **2** (0,0%) | 10 **(0,0%)** | 10 **(0,0%)** | **10** (5,9%) | 10 **(0,0%)** | **10** (0,0%) |
| **27,7%** | **40,0%** | **10,0%** | **11,9%** | **15,9%** | **20,0%** | **16,4%** |

**Table 4:** Indicators for the 100 Italian Internet sites for category.

**LEGENDA (Tables 4, 5, and 6)**

**(a)** **INDICATORS**

**1** *Definition of electric, magnetic and electromagnetic fields*
**2** *Description of physical effects of the emf*
**3** *Description of biological and health effects of the emf*
**4** *Description of the environmental sources*
**5** *Indication of the environmental levels produced by the emf sources*
**6** *Legislation*
**7** *Risk perception*
**8** *Frequently Asked Questions (FAQ)*
**9** *Links*
**10** *Forum*

**(b)** *The Global Mean Percentage of any categories is reported in the last row.*

**Categories for the English key words "emf+h"**

| Public Research Institutes | Health and Environ. Author. | National Author. | Companies Commercial sites | Ass. - Ass. no profit | Scientific Ass. | Mass media, magazines, info. sites |
|---|---|---|---|---|---|---|
| 9 **(28,6%)** | 9 **(56,3%)** | 3 **(50,0%)** | 9 **(23,8%)** | 9 **(50,0%)** | 1 **(50,0%)** | 9 **(30,8%)** |
| 3 **(14,3%)** | 1 **(37,5%)** | 6 **(50,0%)** | 4 **(19,0%)** | 3 **(18,8%)** | 2 **(50,0%)** | 2 **(23,1%)** |
| 6 **(14,3%)** | 3 **(37,5%)** | 9 **(50,0%)** | 3 **(14,3%)** | 4 **(12,5%)** | 3 **(50,0%)** | 1 **(15,4%)** |
| 8 **(14,3%)** | 6 **(37,5%)** | 1 **(25,5%)** | 8 **(14,3%)** | 5 **(12,5%)** | 6 **(50,0%)** | 3 **(15,4%)** |
| 1 **(7,1%)** | 4 **(25,0%)** | 2 **(25,5%)** | 1 **(9,5%)** | 8 **(12,5%)** | 9 **(50,0%)** | 4 **(7,7%)** |
| 2 **(7,1%)** | 2 **(12,5%)** | 8 **(25,5%)** | 5 **(9,5%)** | 1 **(6,3%)** | 4 **(0,0%)** | 5 **(7,7%)** |
| 4 **(0,0%)** | 5 **(12,5%)** | 4 **(0,0%)** | 6 **(4,8%)** | 6 **(6,3%)** | 5 **(0,0%)** | 6 **(7,7%)** |
| 5 **(0,0%)** | 8 **(12,5%)** | 5 **(0,0%)** | 2 **(0,0%)** | 10 **(6,3%)** | 7 **(0,0%)** | 10 **(7,7%)** |
| 7 **(0,0%)** | 7 **(6,3%)** | 7 **(0,0%)** | 7 **(0,0%)** | 2 **(0,0%)** | 8 **(0,0%)** | 7 **(0,0%)** |
| 10 **(0,0%)** | 10 **(0,0%)** | 10 **(0,0%)** | 10 **(0,0%)** | 7 **(0,0%)** | 10 **(0,0%)** | 8 **(0,0%)** |
| **8,6%** | **23,8%** | **30,0%** | **9,5%** | **12,5%** | **25,0%** | **11,5%** |

**Table 5:** Indicators for the 100 English Internet sites for category.

For the Italian research, "*Health and Environmental Authorities*" and "*Public Research Institutes*" have the most exhaustive sites with the highest scores for the *GMP* (respectively 40,0% and 27,7%). "*Health and Environmental Authorities*" fail only for the "*Description of physical effects of the emf*". "*National Authorities*", although having a *GMP* of 10%, show an interesting occurrence of "*Risk perception*" (50%). "*Associations and no-profit Associations*" represent the only category where all the indicators are treated,

although in very few sites (*GMP* 15,9%). "*Mass media, magazines and information sites*" are not shown because they are incomplete for all the indicators (0%).

**Categories for French key words "chem+s"**

| Public Research Institutes | Health and Environ. Author. | National Author. | Companies Commercial sites | Ass. - Ass. no profit | Scientific Ass. | Mass media, magazines, info. sites | National sites for energy and transport |
|---|---|---|---|---|---|---|---|
| 1 **(25,0%)** | 9 **(100%)** | 6 **(44,4%)** | 9 **(25,0%)** | 9 **(50,0%)** | 1 **(50,0%)** | 4 **(25,0%)** | 1 **(100%)** |
| 9 **(18,8%)** | 3 **(75,0%)** | 3 **(33,3%)** | 1 **(16,7%)** | 3 **(36,4%)** | 9 **(50,0%)** | 5 **(25,0%)** | 5 **(100%)** |
| 2 **(12,5%)** | 6 **(50,0%)** | 9 **(33,3%)** | 4 **(16,7%)** | 6 **(31,8%)** | 2 **(0,0%)** | 9 **(25,0%)** | 6 **(100%)** |
| 3 **(12,5%)** | 8 **(50,0%)** | 2 **(22,2%)** | 2 **(12,5%)** | 1 **(18,2%)** | 3 **(0,0%)** | 1 **(12,5%)** | 8 **(100%)** |
| 4 **(12,5%)** | 1 **(25,0%)** | 4 **(22,2%)** | 5 **(12,5%)** | 10 **(13,6%)** | 4 **(0,0%)** | 2 **(12,5%)** | 9 **(100%)** |
| 6 **(12,5%)** | 2 **(25,0%)** | 5 **(22,2%)** | 6 **(12,5%)** | 2 **(9,1%)** | 5 **(0,0%)** | 3 **(12,5%)** | 4 **(33,3%)** |
| 8 **(12,5%)** | 4 **(25,0%)** | 7 **(11,1%)** | 8 **(12,5%)** | 8 **(9,1%)** | 6 **(0,0%)** | 6 **(12,5%)** | 2 **(0,0%)** |
| 5 **(6,3%)** | 5 **(25,0%)** | 8 **(11,1%)** | 3 **(4,2%)** | 4 **(4,5%)** | 7 **(0,0%)** | 8 **(12,5%)** | 3 **(0,0%)** |
| 7 **(0,0%)** | 7 **(0,0%)** | 1 **(0,0%)** | 7 **(4,2%)** | 5 **(4,5%)** | 8 **(0,0%)** | 7 **(0,0%)** | 7 **(0,0%)** |
| 10 **(0,0%)** | 10 **(0,0%)** | 10 **(0,0%)** | 10 **(0,0%)** | 7 **(0,0%)** | 10 **(0,0%)** | 10 **(0,0%)** | 10 **(0,0%)** |
| **11,3%** | **37,5%** | **20,0%** | **11,7%** | **17,7%** | **10.0%** | **13,8%** | **53,3%** |

**Table 6:** Indicators for the 100 French Internet sites for category.

For the international English research, "*National Authorities*" have the most exhaustive sites (*GMP* 30%) and stand out for the importance of "*Description of the biological and health effects of the emf*", "*Legislation*" and "*Links*" (50%). "*Public Research Institutes*" and "*Companies and Commercial sites*" have the less exhaustive sites (*GMP* respectively 8,6% and 9,5%). "*Health and Environmental Authorities*", although the *GMP* is 23,9%, is the only category where all the indicators are examined, with the exception of "*Forum*". Only here and in the French research, we find "*Mass media, magazines and information sites*", with a *GMP* of 11,5%. For the international French research, "*National sites of energy and transport*" have the most exhaustive sites (*GMP* 53,3%), although four important indicators are not treated. This category shows 100% for the indicators "*Definition of electric, magnetic and electromagnetic fields*", "*Indication of the environmental levels produced by the emf sources*", "*Legislation*", "*FAQ*" and "*Links*", never checked in the other languages. In the second place we find "*Health and Environmental Authorities*" with a *GMP* of 37,5%, and in the lowest rank there are "*Scientific Associations*" (*GMP* 10%) with only two indicators treated ("*Definition of electric, magnetic and electromagnetic fields*" and "*Links*").

| "cem+s" Italian: 100 sites | | "emf+h" English: 100 sites | | "chem+s" French: 100 sites | |
|---|---|---|---|---|---|
| **1** | **Definition of electric, magnetic and electromagnetic fields (%)** | | | | |
| Health and Environ. Authorities | 66,7 | Scientific Associations | 50,0 | Nation. sites for en. and | 100,0 |
| Public Research Institutes | 38,5 | Health and Environ. Authorities | 37,5 | Scientific Associations | 50,0 |
| Local Authorities | 18,2 | National Authorities | 25,0 | Public Research Institutes | 25,0 |
| Associations and Ass. no profit | 17,6 | Mass Media, magazines, inf. sites | 15,4 | Health and Environ. Authorities | |
| Companies and Commercial sites | 6,3 | Companies and Commercial sites | 9,5 | Associations and Ass. no profit | 18,2 |
| National Authorities | 0 | Public Research Institutes | 7,1 | Companies and Commercial sites | 16,7 |
| Scientific Associations | | Associations and Ass. no profit | 6,3 | Mass Media, magazines, inf. sites | 12,5 |
| | | | | National Authorities | 0 |
| **2** | **Definition of physical effects of the *emf* (%)** | | | | |
| Companies and Commercial sites | 50,0 | Scientific Associations | 50,0 | Health and Environ. Authorities | 25,0 |
| Public Research Institutes | 46,2 | National Authorities | 25,0 | National Authorities | 22,2 |
| Local Authorities | 27,3 | Mass Media, magazines, inf. sites | 23,1 | Public Research Institutes | 12,5 |
| Associations and Ass. no profit | 11,8 | Health and Environ. Authorities | 12,5 | Companies and Commercial sites | |
| National Authorities | 0,0 | Public Research Institutes | 7,1 | Mass Media, magazines, inf. sites | |
| Health and Environ. Authorities | | Companies and Commercial sites | 0,0 | Associations and Ass. no profit | 9,1 |
| Scientific Associations | | Associations and Ass. no profit | 6,3 | Nation. sites for en. and | 0,0 |
| | | | | Scientific Associations | |
| **3** | **Definition of biological and health effects of the *emf* (%)** | | | | |
| Health and Environ. Authorities | 66,7 | National Authorities | 50,0 | Health and Environ. Authorities | 75,0 |
| Public Research Institutes | 61,5 | Scientific Associations | | Associations and Ass. no profit | 36,4 |
| National Authorities | 50,0 | Health and Environ. Authorities | 37,5 | National Authorities | 33,3 |
| Scientific Associations | | Associations and Ass. no profit | 18,8 | Public Research Institutes | 12,5 |
| Local Authorities | 45,5 | Mass Media, magazines, inf. sites | 15,4 | Mass Media, magazines, inf. sites | |
| Companies and Commercial sites | 31,3 | Public Research Institutes | 14,3 | Companies and Commercial sites | 4,2 |
| Associations and Ass. no profit | 29,4 | Companies and Commercial sites | 14,3 | Nation. sites for en. and | 0,0 |
| | | | | Scientific Associations | |
| **4** | **Description of the environmental sources (%)** | | | | |
| Health and Environ. Authorities | 66,7 | Health and Environ. Authorities | 25,0 | Nation. sites for en. and | 33,3 |
| Scientific Associations | 50,0 | Companies and Commercial sites | 19,0 | Health and Environ. Authorities | 25,0 |
| Public Research Institutes | 38,5 | Associations and Ass. no profit | 12,5 | Mass Media, magazines, inf. sites | |
| Companies and Commercial sites | 25,0 | Mass Media, magazines, inf. sites | 7,7 | National Authorities | 22,2 |
| Local Authorities | 18,2 | Public Research Institutes | 0,0 | Companies and Commercial sites | 16,7 |
| Associations and Ass. no profit | 17,6 | National Authorities | | Public Research Institutes | 12,5 |
| National Authorities | 0,0 | Scientific Associations | | Associations and Ass. no profit | 4,5 |
| | | | | Scientific Associations | 0,0 |
| **5** | **Indication of the environmental levels produced by the *emf* sources (%)** | | | | |
| Health and Environ. Authorities | 66,7 | Health and Environ. Authorities | 12,5 | Nation. sites for en. and | 100,0 |
| Scientific Associations | 50,0 | Associations and Ass. no profit | 12,5 | Health and Environ. Authorities | 25,0 |
| Associations and Ass. no profit | 17,6 | Companies and Commercial sites | 9,5 | Mass Media, magazines, inf. sites | 25,0 |
| Local Authorities | 9,1 | Mass Media, magazines, inf. sites | 7,7 | National Authorities | 22,2 |
| Public Research Institutes | 7,7 | Public Research Institutes | 0,0 | Companies and Commercial sites | 12,5 |
| Companies and Commercial sites | 6,3 | National Authorities | | Public Research Institutes | 6,3 |
| National Authorities | 0,0 | Scientific Associations | | Associations and Ass. no profit | 4,5 |
| | | | | Scientific Associations | 0,0 |
| **6** | **Legislation (%)** | | | | |
| Health and Environ. Authorities | 50,0 | National Authorities | 50,0 | Nation. sites for en. and | 100,0 |
| Companies and Commercial sites | 31,3 | Scientific Associations | | Health and Environ. Authorities | 50,0 |
| Public Research Institutes | 30,8 | Health and Environ. Authorities | 37,5 | National Authorities | 44,4 |
| Associations and Ass. no profit | 23,5 | Public Research Institutes | 14,3 | Associations and Ass. no profit | 31,8 |
| Local Authorities | 9,1 | Mass Media, magazines, inf. sites | 7,7 | Public Research Institutes | 12,5 |
| National Authorities | 0,0 | Associations and Ass. no profit | 6,3 | Companies and Commercial sites | |
| Scientific Associations | | Companies and Commercial sites | 4,8 | Mass Media, magazines, inf. sites | |
| | | | | Scientific Associations | 0,0 |

**Table 7:** Percentage distributions for each information indicator on categories using the Italian, English and French key words "cem+s", "emf+h", "chem+s".

| "cem+s" Italian: 100 sites | | "emf+h" English: 100 sites | | "chem+s" French: 100 sites | |
|---|---|---|---|---|---|
| **7** | | **Risk perception (%)** | | | |
| National Authorities | 50,0 | Health and Environ. Authorities | 6,3 | National Authorities | 11,1 |
| Health and Environ. Authorities | 16,7 | Public Research Institutes | 0,0 | Companies and Commercial sites | 4,2 |
| Local Authorities | 9,1 | National Authorities | | Nation. sites for en. and | 0,0 |
| Companies and Commercial sites | 6,3 | Companies and Commercial sites | | Health and Environ. Authorities | |
| Associations and Ass. no profit | 5,9 | Associations and Ass. no profit | | Associations and Ass. no profit | |
| Scientific Associations | 0,0 | Scientific Associations | | Public Research Institutes | |
| Public Research Institutes | | Mass Media, magazines, inf. sites | | Mass Media, magazines, inf. sites | |
| | | | | Scientific Associations | |
| **8** | | **Frequently Asked Questions (FAQ) (%)** | | | |
| Health and Environ. Authorities | 33,3 | National Authorities | 25,0 | Nation. sites for en. and | 100,0 |
| Local Authorities | 9,1 | Public Research Institutes | 14,3 | Health and Environ. Authorities | 50,0 |
| Public Research Institutes | 7,7 | Companies and Commercial sites | | Companies and Commercial sites | 12,5 |
| Associations and Ass. no profit | 5,9 | Health and Environ. Authorities | 12,5 | Mass Media, magazines, inf. sites | |
| Companies and Commercial sites | 0,0 | Associations and Ass. no profit | | Public Research Institutes | |
| National Authorities | | Scientific Associations | 0,0 | National Authorities | 11,1 |
| Scientific Associations | | Mass Media, magazines, inf. sites | | Associations and Ass. no profit | 9,1 |
| | | | | Scientific Associations | 0,0 |
| **9** | | **Links (%)** | | | |
| Public Research Institutes | 46,2 | Health and Environ. Authorities | 56,3 | Nation. sites for en. and | 100,0 |
| Associations and Ass. no profit | 23,5 | National Authorities | 50,0 | Health and Environ. Authorities | |
| Local Authorities | 18,2 | Associations and Ass. no profit | | Associations and Ass. no profit | 50,0 |
| Health and Environ. Authorities | 16,7 | Scientific Associations | | Scientific Associations | |
| Companies and Commercial sites | 12,5 | Mass Media, magazines, inf. sites | 30,8 | National Authorities | 33,3 |
| National Authorities | 0,0 | Public Research Institutes | 28,6 | Companies and Commercial sites | 25,0 |
| Scientific Associations | | Companies and Commercial sites | 23,8 | Mass Media, magazines, inf. sites | |
| | | | | Public Research Institutes | 18,8 |
| **10** | | **Forum (%)** | | | |
| Health and Environ. Authorities | 16,7 | Mass Media, magazines, inf. sites | 7,7 | Associations and Ass. no profit | 13,6 |
| Associations and Ass. no profit | | Associations and Ass. no profit | 6,3 | Nation. sites for en. and | 0,0 |
| Companies and Commercial sites | 0,0 | Public Research Institutes | 0,0 | Health and Environ. Authorities | |
| Public Research Institutes | | Health and Environ. Authorities | | Scientific Associations | |
| Local Authorities | | National Authorities | | National Authorities | |
| National Authorities | | Companies and Commercial sites | | Companies and Commercial sites | |
| Scientific Associations | | Scientific Associations | | Mass Media, magazines, inf. sites | |
| | | | | Public Research Institutes | |

**Table 8:** Percentage distributions for each communication indicator on categories using the Italian, English and French key words "cem+s", "emf+h", "chem+s".

## 5.Global Mean Percentages per national and international areas

The *Global Mean Percentages* for all the categories for the researches including the *health* with key words in Italian, English and French are reported in Table 9. "*Health and Environmental Authorities*" are in the highest ranks in the Italian and French areas and differ in a significant way respect to the English area.

Italian "*Public Research Institutes*" show a high *GMP* that differs in a significant way respect to English and French languages, where "*Public Research Institutes*" are in the lower ranks. "*National Authorities*" have an important role in the international area (English and French) and differ in a significant way compared with the Italian setting.

"*Scientific Associations*" show an important occurrence in the Italian and English international areas respect to the French setting where they are located in the lowest rank.
"*Associations and no-profit Associations*" don't differ in a significant way both in the national and international areas. The less exhaustive category for the national and international areas is the "*Companies and Commercial sites*" that don't differ in a significant way.

| **Categories** | **Global Mean Percentages for the researches with key word in:** | | |
|---|---|---|---|
| | **Italian "cem+s"** | **English "emf+h"** | **French "chem+s"** |
| Public Research Institutes | 27,7% | 8,6% | 11,3% |
| Health and Environmental Authorities | 40,0% | 23,8% | 37,5% |
| Local Authorities | 16,4% | - | - |
| Associations and Ass. no profit | 15,9% | 12,5% | 17,7% |
| Companies and Commercial sites | 11,9% | 9,5% | 11,7% |
| Mass media, magazines and information sites | - | 11,5% | 13,8% |
| National Authorities | 10,0% | 30,0% | 20,0% |
| Scientific Associations | 20,0% | 25,0% | 10,0% |
| National sites for energy and transports | - | - | 53,3% |

**Table 9:** Global mean percentages for all the categories, using the Italian, English and French key words "cem+s", "emf+h", "chem+s".

**Conclusions**

The first 100 Internet sites, supplied by the search engine GOOGLE with key words respectively in Italian, English and French ("campi elettromagnetici"-"campi elettromagnetici e salute", "electromagnetic fields"-"electromagnetic field and health", "champs électromagnétiques"-"champs électromagnétiques et santé") have been analysed. Ten indicators, selected to explain the phenomenon, have been defined and searched in each site. Eleven main categories of sites have been selected and the presence of the 10 indicators has been evaluated per categories. This study shows that there are no differences in the *Internet* search using the key words "*emf*" or "*emf and health*" in the national and international area. This shows how *health* is important in relation with *electromagnetic fields*.

The *Internet* sites of the national and international area are built on the different cultures of their countries, showing the relevance of their public, national and local authorities. It is interesting how "*National sites of energy and transport*" and "*Associations and no-profit Associations*" play a relevant and unique role in the French area.

"*Health and Environmental Authorities*", "*National Authorities*" and "*National sites of energy and transport*" have the most exhaustive sites respectively in the Italian, English and French researches, although the number of their sites is small. On the contrary, the "*Companies and Commercial sites*" show the highest number of sites in the national and international area, but they are mostly incomplete. The "*Associations and no-profit*

*Associations*" show their role in trying to establish a dialogue at the national and international level, using "*Forum*".

The "*Description of the biological and health effects of the emf* " stands out in the Italian area, underlying the particular interest on the health effects. The "*Links*" stand out for the international English and French area, showing the international capability to mainly design *Internet* as a hyper textual tool. "*Frequently Asked Questions*", "*Forum*" and "*Risk Perception*", that we have considered as communication indicators, show the lack of dialogue with the end user in the national and international English area.
Our results show a need to consider *Internet* more as a hyper textual and dialogue tool. Standards for *information* and *communication* on "EMF" and "EMF *and health*" have to be designed, taking our results into account.

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8. Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) 1999/519/CE/30 July 1999.

Also websites:

http://www.internetworldstats.com/stats.htm

http://www.eiaa.net

## Representation of Mobile Phone-related Studies in the FEMU EMF-Portal

S. Driessen, D. Dechent, A. Schmidt, R. Wienert, F. Klubertz, and J. Silny

RWTH Aachen University, University Hospital Aachen, Research Center for Bioelectromagnetic Interaction, Aachen, Germany

**Abstract**

According to yellow press reports there are several thousand mobile phone-related articles. With the aid of the Internet Information System "EMF-Portal" it is possible to collect, archive, categorize and evaluate scientific studies on the effects of mobile phones systematically. It is the objective of this work to clarify the actual number of scientific mobile phone-related studies and their thematic profiles in order to provide an accurate discussion basis for possible health risk assessment or for risk communication in general. Mobile phone-related articles are defined as articles on mobile phone exposure, i.e. studies dealing with all frequencies within the frequency range of mobile phones (800 MHz - 2000 MHz) and where the authors explicitly stated their intention to investigate the effects of mobile phone related frequencies. Currently (13 July 2007), there are 1054 studies covering this topic almost completely. Out of these 1054 studies, there are 370 experimental medical and biological studies as well as 75 epidemiological studies (of which comparable and comprehensive summaries are available in the EMF-Portal). The report provides an overview of the increase of these studies over the last 15 years and their thematic categorization as well as a survey of their countries of origin and their funding institutions. Thus, accurate data are presented on the actual number of scientific mobile phone related studies and their thematic profiles.

### Introduction

Wireless communication swept the world during the last decade and today more than 1.4 billion people rely on mobile telephony, or around 20 % of the world's population (Valberg et al. 2007). With the development and application of these new technologies, especially of mobile phones, there is growing concern regarding the possible health effects of radiofrequency electromagnetic fields emitted by these devices.

Despite intensive research there is still a controversial discussion regarding the possible health risks of electromagnetic fields emitted by mobile phones (for review see Valberg et al. 2007, Health Protection Agency 2006; Gezondheidsraad Jaarbericht 2005; Karger 2005; Ahlbom et al 2004, Feychting et al. 2005, NRBA 2004, Zwamborn 2003, Habash 2003). Due to the large amount of scientific investigations and their big methodological differences the data of these studies have to be evaluated regarding their quality and their relevance for the human health (Hug and Rapp 2006). This evaluation has to be conducted for every single study as well as for a more general context for all experimental in vitro, in vivo, and epidemiological studies of a specific research area.

The most reliable basis for the assessment of current knowledge is the worldwide scientific literature, which so far already amounts to more than 10,000 publications in the area of environmental compatibility of electromagnetic fields, even when counting only those published in peer-reviewed journals. Scientific investigations are the basis for the

assessment of current knowledge status on the consequences of electromagnetic field exposure for the health of persons or the environment.

It is difficult and time-consuming to find related publications in a collection of more than 10,000 studies. Additionally, the constantly growing body of literature is very specific regarding the subjects currently discussed and the variety of questions posed. Today, literature research is generally carried out using Internet databases, which – beyond the mere bibliographical data – provide a variety of additional information and are available under specific terms and conditions. For example, through the journal literature search system PubMed (2007), the by far largest medical database, virtually anyone can access more than 15,000,000 biomedical journal citations of publications since 1966. Currently, it contains about 9,000 articles related to EMF.

As an alternative, specific databases pertaining to EMF can be used. The EMF Database (2007) provides about the same scope of information as PubMed, but additionally collects records of poster sessions and meeting abstracts. However, the use of its Internet interface is limited to a number of basic operations and the viewing of a handful of sample records; the use of the complete CD version containing third-party abstracts is subject to the payment of a fee. In contrast, the International EMF Research Database (2007) and the World Health Organization EMF Database (2007) are free of charge and provide additional descriptors and search options such as the type of the study and the end points pursued. These databases, however, are currently very focused on the RF part of the EMF spectrum. While ongoing projects are described, the citations listed are predominantly peer-reviewed publications in English language journals. The database ELMAR (Hug et al. 2006) also contains additional descriptors regarding endpoints, materials, methods and results, but is incomprehensive and is available only in German.

Currently, only our Internet Information System EMF-Portal (http://www.emf-portal.org) introduced here provides concise, comparable and comprehensible summaries of scientific research results (in English and German) covering studies published in the last 25 years on the effects of EMF on humans and the environment. The EMF-Portal is accessible free of charge. An “introduction to the fundamentals of the effects of EMF”, a “database of exposure sources occurring in everyday life” and a “glossary” are available as supporting tools.

The principal item of the EMF-Portal is the literature database. Within the scope of the EMF-Portal, articles in the area of bio-electromagnetic interaction of low frequency and radiofrequency fields with the organism are researched in more than 1,170 scientific journals on a regular basis, and approximately 600 studies are added per year. Articles included in the database are mainly from peer-reviewed journals or detailed working reports and research reports if they comprehensively describe the methodology applied and the experiments conducted. Summaries of individual publications are made of epidemiological and experimental studies from the medical–biological area. Thus, the user gets a general idea concerning the essential contents of the processed publications without the need for access to the original full text. The structure of the representation is always similar. This serves the purpose of a quick orientation as well as an optimum comparability of the studies with one another.

According to yellow press reports there are several thousand mobile phone-related articles. With the aid of the EMF-Portal it is possible to systematically collect, archive, categorize and evaluate scientific experimental studies on the biological and medical effects of mobile phones. In the meantime, all scientific experimental studies on the biological and medical effects of mobile phone exposure as well as all epidemiological studies published so far have been summarized and are represented online; new publications are continuously added and evaluated.

The aim of this work is to analyse and categorize all these mobile phone-related articles available in the EMF-Portal. Even if there are summaries of all mobile phone related experimental and epidemiological studies within the EMF-Portal, the current investigation aims at giving a more general overview over the study categories and general descriptors rather than evaluating the scientific contents. Scientific contents of individual studies are available via Internet access (www.emf-portal.org).

**Materials and Methods**

So far, approximately 11,000 publications from more than 1,170 journal mainly peer-reviewed scientific journals have been taken up in the database and categorized into different subject areas.

The following identical in-house classification criteria are applied to all registered publications: First, all publications are sorted according to their study types into the basic categories “experimental study”, “dosimetric study”, “epidemiological study” or “other/theoretical study type”. Subsequently the general exposure data of the studies are registered as well as the exposure source the authors intended to study, if explicitly denoted (for example “mobile phone”, “base station”, “W-LAN”, “Radar”, “power transmission line”, etc.).

After this initial classification, the publications are assigned to 60 different subgroups (so-called thematic profiles) depending on the subject area they are dealing with. For example, experimental studies are divided into approximately 48 different thematic profiles collecting studies with endpoints like “blood-brain barrier”, “behaviour”, “cancer”, “genotoxicity”, “hypersensitivity”, “teratogenicity” etc. Typical profiles from the “theoretical study type” are “review articles”, “comments” or “basic articles”.

Furthermore, comprehensive summaries of experimental medical or biological studies as well as of epidemiological are produced according to a standardized protocol.

Concerning the current data collection, mobile phone-related articles are defined as articles with mobile phone exposure, i.e. studies dealing with all frequencies within the frequency range of mobile phones (800 MHz - 2000 MHz) and where the authors explicitly stated their intention to investigate the effects of mobile phone-related frequencies. A broad customized database query was performed with mobile phone-related terms (such as cellular phone, mobile phone, BTS, UMTS, GSM) and within the corresponding frequency ranges in original article abstracts of 10,630 articles and full texts of 7,446 indexed publications already available. Subsequently, the results were checked for false positive publications in the sense of the criteria described above.

Evaluation of the mobile phone-related articles comprises determination of the different categories (study type and thematic profile), year of publication, origin country of the mobile phone related study in general as well as of the experimental biological or medical studies.
Furthermore the evaluation of the articles includes a categorization of the investigated endpoints of the experimental studies, i.e. an overview about the most studied organ systems or in vitro systems. Finally, an overview over the funding institutions, which are involved most frequently in mobile phone related experimental medical or biological studies, is given.

**Results**

Annual increase of the number of mobile phone related studies

As shown in Figure 1 the number of mobile phone related studies (∑ 1054) increased linearly since the nineties up to 172 in 2005. In 2006 there were 168 articles registered within the EMF-Portal; in 2007 there are already 88 studies registered (data not shown). Additional 18 articles have been ordered and are due for delivery.

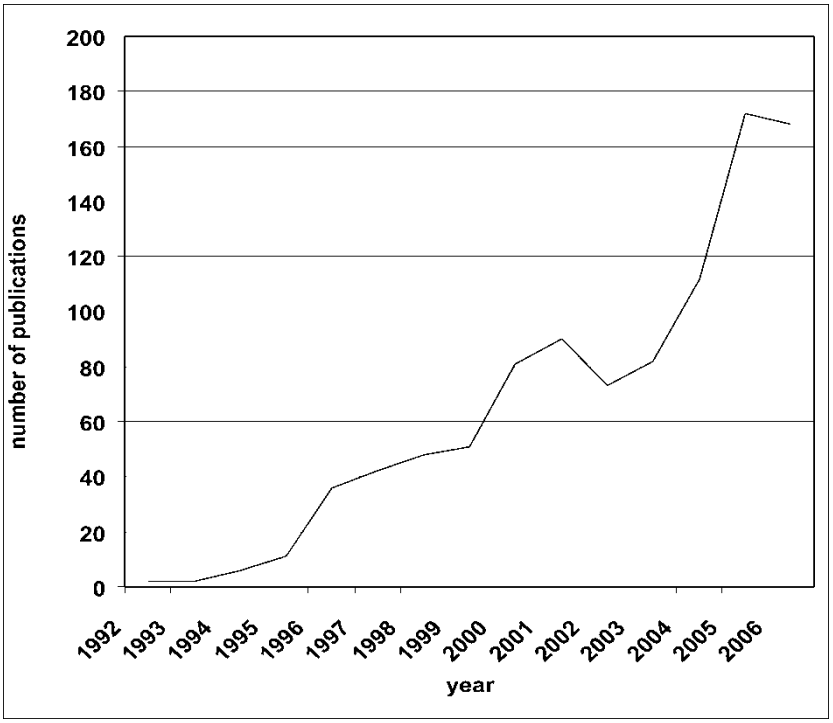


Figure 1: Development of the numbers of mobile phone related studies during the last 15 years

Categorization of mobile phone related publications

Altogether there are 1054 mobile phone-related articles registered in the EMF-Portal database (status quo: 13 July 2007). Approximately one third of these studies (n=370) are experimental biological or medical studies (Figure 2). Furthermore, there are 75 epidemiological studies. Additionally, there are 155 dosimetric or technical studies and 73 studies on the effects of EMF on electrical implants or electromagnetic interference

studies, respectively. Finally, there is a relatively large number (n=307) of theoretical or review articles (reviews/surveys n=105; comments/basic articles n=191; international guidelines n=11), i.e. between one fourth and one third of all articles are of theoretical or recapitulative nature and thus, they are often based on the contents of the experimental or epidemiological data. The remaining 74 publications are studies in other languages (not German or English, n=56) and ordered studies not yet available (18 studies).

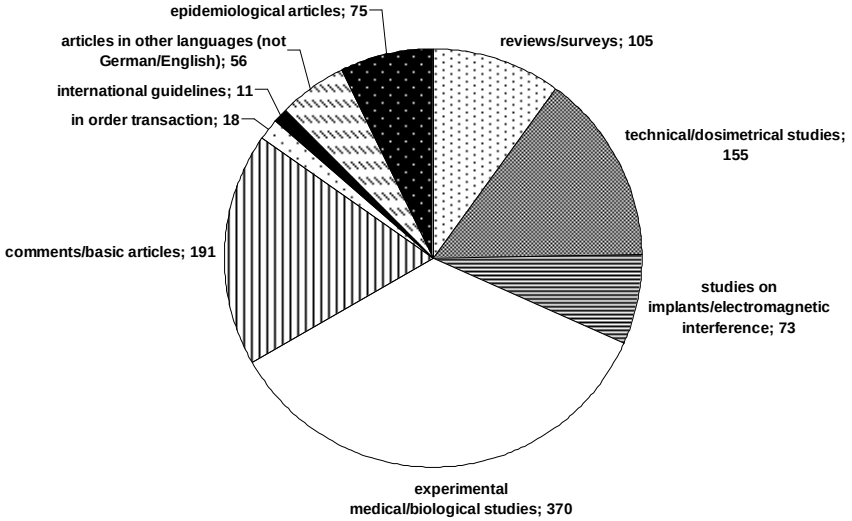


Figure 2: Categorization of mobile phone related publications (∑=1054)

Origin of mobile phone related articles

The data of Figure 3 shows that of the 1054 mobile phone related-articles, most are written by scientists in the USA (n=171), Germany (n=132), UK (n=95), Sweden (n=79), and Italy (n=67). If only publications with English as their original article language are considered (and articles in German are excluded), there are only 89 publications from Germany, but Germany is still one of the countries where most articles are authored.

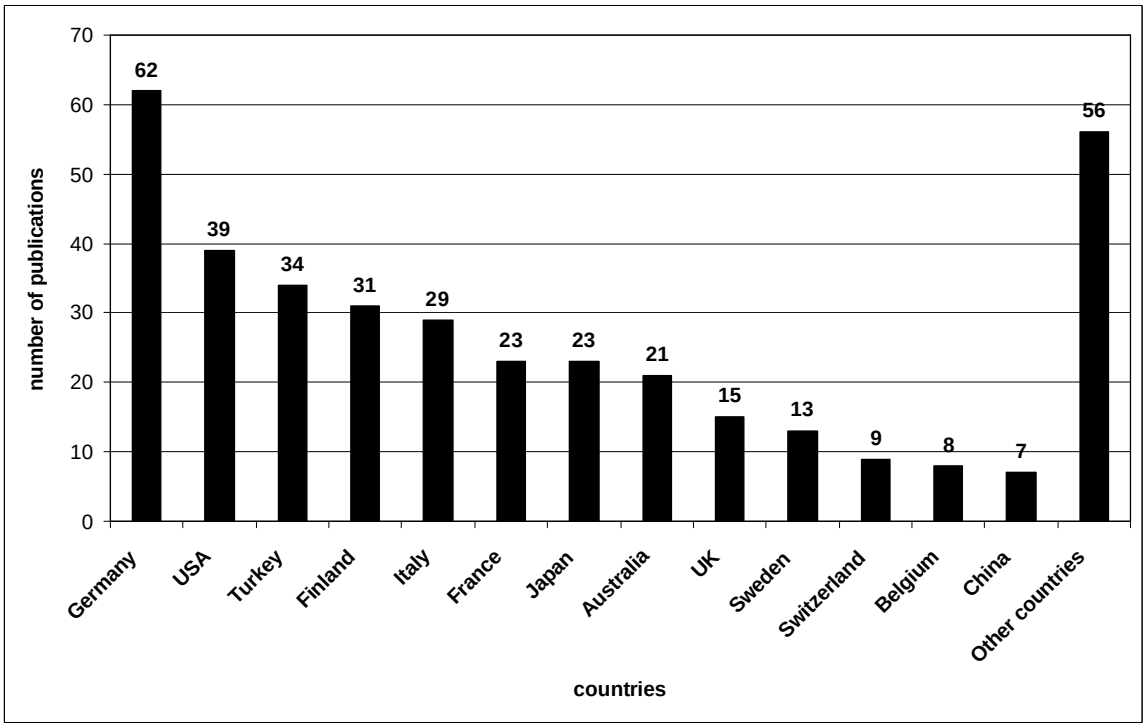


Figure 3: Origin of mobile phone related studies. If only publications in English (as original article language) are considered, there are only 89 publications form Germany, 32 articles from Switzerland and 14 articles from Austria.

Origin of mobile phone related experimental studies

If only the origin of the 370 experimental biological or medical studies is examined, Germany (n=62) and the USA (n=39) contribute the highest number of practical work (Figure 4). If only publications with English as their original article language are considered (and articles in German are excluded), there are only 46 publications from Germany, but Germany is still one of the countries with the highest yield of experimental studies. In Turkey (n=34), in Finland (31) as well as in Italy (n=29) a similar amount of studies is conducted.

Categorization of epidemiological mobile phone related articles

The most frequently investigated endpoint of the 75 epidemiological mobile phone-related studies is cancer. A majority of 35 publications is dealing with brain cancer, 5 studies investigated leukaemia and lymphoma and 25 studies focus on other cancer types.

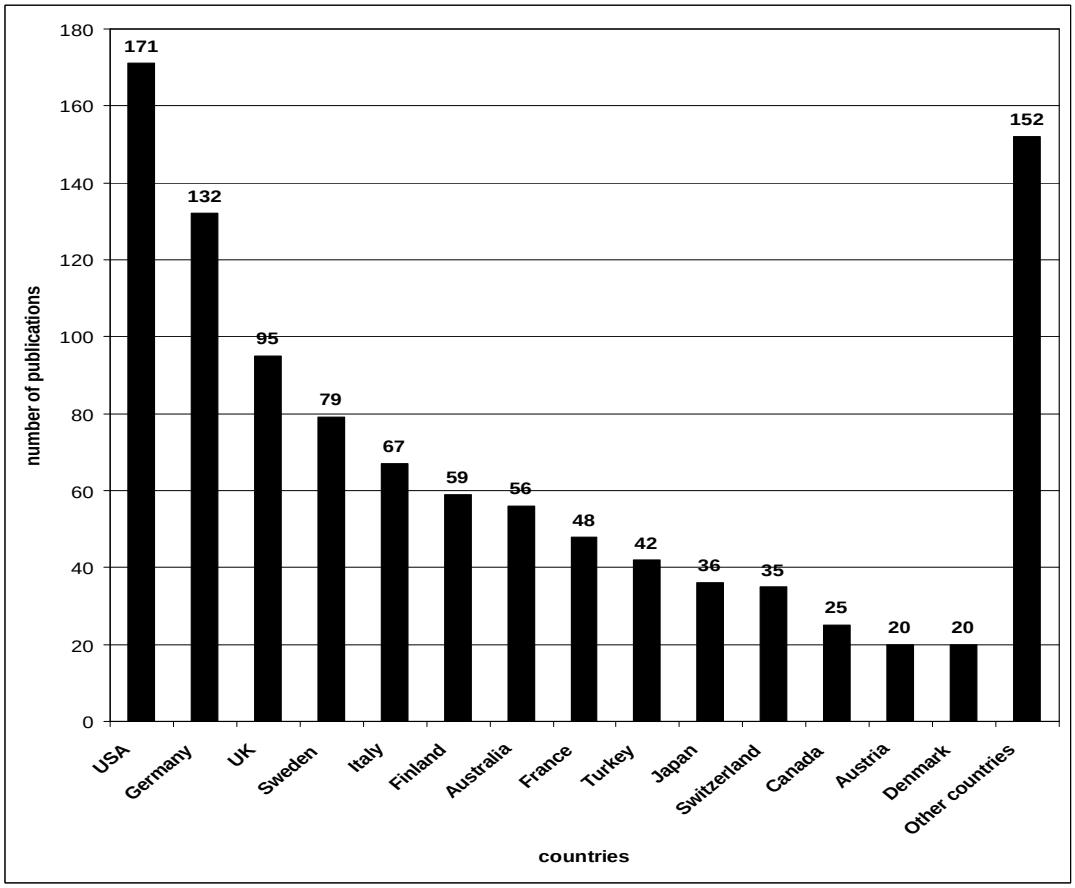


Figure 4: Origin of mobile phone related experimental biological or medical studies. If only publications in English (as original article language) are considered, there are only 46 publications from Germany.

Categorization of experimental mobile phone related articles

The most frequently investigated organ system within the 370 experimental biological or medical studies is the central nervous system (Figure 5). There are 59 publications regarding this organ system investigating endpoints such as EEG alterations (n=29), brain/neuronal activity (n=17), cerebral blood flow (n=5), or brain metabolism (n=8). Studies on blood brain barrier (n=16) are listed in a separate thematic profile. Other common in vivo studies deal with cancer (n=28), cognitive function (n=23), auditory system (n=18), hormone secretion (n=17), sleep (n=13), or reproductive system (n=12). Furthermore, there are 47 genotoxicity studies.

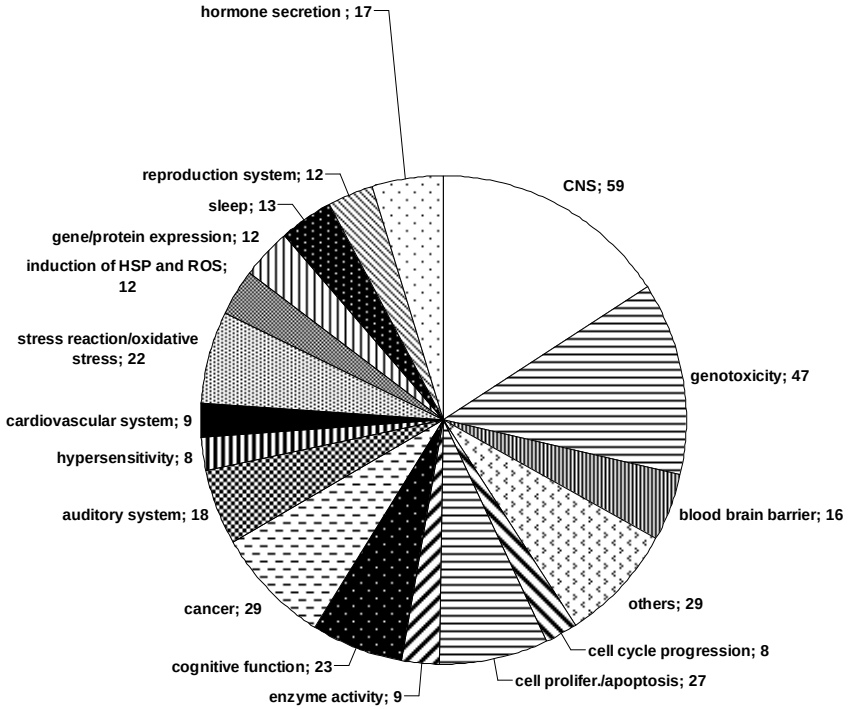


Figure 5: Categorization of experimental mobile phone related publications regarding different endpoints or investigated organ systems (∑=370).

Funding institutions of experimental studies

Funding institutions were evaluated for the 370 experimental biological and medical studies, but for 107 of these studies this information was not available (Table 1). Altogether, 184 different institutions supported the remaining 263 studies were financially supported with an average of nearly 2 institutions supporting each study. Motorola (n=29; 8% of all experimental studies) and the Finnish National Technology Agency Tekes (n=20; 5% of all experimental studies) seem to be two of the most important sponsors, followed by European Union/European Commission (n=18), the Deutsche Telekom (15 funded studies) and Nokia (15 supported studies). The German Research Association for Radio Applications (FGF e.V.) based in Germany supported 12 studies published in English journals; if the German language publications are also considered this institution funded even 21 studies.

**Discussion**

According to yellow press reports there are several thousand mobile phone-related articles. Even during scientific congress debates scientists, decision makers and other representatives often claim that there are “enough”, “a huge amount”, or “several hundred” mobile phone related studies. Vague numbers of studies and publications are referred to without any substantiated basis and without differentiating where the studies have been published (peer-reviewed journal, poster session, congress presentation, newspaper, etc.). The current study aims to shed some light on the actual number of

mobile phone-related studies and their thematic focus in order to provide an accurate basis for discussion. Exact data are not only important for the purpose of general discussion but also for the assessment of future research needs.

The WHO (Valberg 2007) demands access to accurate information on the effects of electromagnetic fields for the public and for education on scientific consensus positions as an important step in risk communication. Communication with the public about environmental risks from technology plays an important role in risk communication (WHO 2002, Brodsky 2003). Karger (2005) points out the importance to communicate the results of scientific research to the public in a transparent and differentiated way. In the case of electromagnetic fields, for example, the general public often is not adequately informed of the risks associated with them, and as a consequence anxieties and fears of this technology arise. Wiedemann (1998) argues that many of the problems associated with the EMF issue involve communication failures. Conflicting safety reports from the experts and sensationalistic media coverage frequently add to anxiety (Brodsky 2003). For Karger (2005) there is no other way to achieve acceptance of any policy than to communicate the scientific background to the public in a highly transparent way.

The online information system “EMF-Portal” provides the required information and scientific data regarding the biomedical effects of electromagnetic fields in an adequate, clear and similar way. Out of the 1054 mobile phone-related studies, there are 370 comprehensive summaries of experimental medical and biological studies as well as of 75 epidemiological studies. When narrowed to human laboratory in vivo studies, there are 110 experimental medical and biological studies. Huss et al. (2007) by contrast only found 59 studies, although their selection criteria were similar to those of the EMF-Portal’s.

Thus, on the one hand, the EMF-Portal provides exact data about literature statistics, i.e. what kind of studies are available in corresponding frequency ranges and what endpoints they are dealing with. On the other hand, the user can gain insight into the contents of individual studies. The EMF-Portal combines a literature reference administration system with an information management system: Accurate data on the EMF issue are provided and scientific research results can be communicated in a highly transparent way. Thus, the EMF-Portal serves as an important tool for experts or decision makers in the process of identifying and assessing hazards of electromagnetic fields as well as for associated future research needs. With the aid of the supporting tools “glossary” and the “introduction to the fundamentals of the effects of EMF” scientific data become also comprehensible even for the interested public (which is the missing deficient step in current risk communication).

Despite the advantages described above the validation of the consistency of a postulated effect still remains a problem. The review of health effects due to mobile phone-related frequencies, for example, is a demanding and time-consuming process even if the physical, biological and medical expert knowledge is available. In the course of this process all publications dealing with a defined EMF frequency range and a particular biological or medical endpoint have to be collected and evaluated individually in view to their quality and reproducibility. But the next required step, the validation of the consistency of a postulated effect in the profiles of literature resulting from similar investigations is - to a certain extent – a subjective process in which a high level of expert knowledge and the ability to interpret scientific results adequately are essential. The same

problems and requirements arise when trying to assess the complementarities of the results reported between the categories of in vitro, in vivo and epidemiological studies; therefore a comprehensive evaluation like that should be preferably conducted independently by more than one expert, if possible. Owing to the rapid growth of the body of literature in this area of research with an annual increment of about 600 publications, this evaluation process should be repeated at least every 4 or 5 years.

For such a process the EMF-Portal represents a powerful and effective instrument becoming indispensable with the growing body of literature. Furthermore, the EMF-Portal serves as a model literature database and information management system for other controversially discussed subjects such as climate change, nanotechnology, gene technology or chemical toxicology.

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## Communicating on EMF with Political Audiences – the UK Experience

Michael Dolan, Stuart Eke, Nicola Davies, and Genevieve Dolan
*Mobile Operators Association, London, United Kingdom*

### Introduction

The Mobile Operators Association ("MOA") represents the collective interests of the UK's five mobile telecommunications network operators ("the operators") on radiofrequency ("RF") health issues. Some public and media concerns about the safety of mobile phones and the radio base station networks, which support their use have been present in the UK since the late 1990s. MOA's objectives include ensuring that its members earn the trust of the community and are recognised and respected as an industry whose actions and approach to the RF health and associated town planning issues are responsible and where those issues are discussed in a balanced and objective manner. MOA's role includes education of its stakeholders on these issues including new technologies marketed or operated by its members such as 3rd generation mobile technology.

In terms of managing these issues for its members at an industry level, MOA has engaged with a range of stakeholders including political audiences at both local and national levels. This paper outlines the programmes of MOA's interaction with local government audiences throughout the UK and explores the background to the launching of the 2005/6 major political party annual conference debates and explores the main themes and recommendations, which flowed from them. The paper also outlines briefly some of MOA's ongoing programme of UK political engagement.

### Ten Commitments to best siting practice: Commitment Four – engaging with local government political audiences

In 2001 MOA published its "Ten Commitments to best siting practice" ("Ten Commitments") with the object of improving transparency in the process of building mobile phone networks, providing more information to the public and the 434 local authorities across the UK, and increasing the role of the public in the siting of radio base stations. Detailed information about the Ten Commitments may be found at:
http://www.mobilemastinfo.com/planning/best_practice.htm

The fourth commitment was "*to establish professional development workshops on technological developments within telecommunications for local authority officers and elected members.*" Since the Ten Commitments were published, MOA has conducted over 160 such workshops across the UK, and the programme is ongoing. The overall purpose of the workshops is to ensure transparency of intent and open communication and discussion with particular regard to external stakeholders within local government. This includes assisting UK local authorities ("LAs") in the execution of their statutory consultation obligations. Proactive contact is made with LAs through various methods including approaching newly elected council members in post election periods and identifying the need for education and dialogue through local media reports, direct contact with the MOA, and in response to contact made with regional representatives of the operators. The workshops are designed to increase councillors' and professional

planning officers' knowledge of the development of mobile telecommunications networks, base station site design, and best practice in terms of community consultation.

The format of the workshops is tailored to meet each LA's needs and is arranged following discussions with key planning officers and, in some cases, elected members. Typically the format will involve two short slide presentations designed to address the key issues of interest to the audience. With the agreement of the LA, operator representatives attend and take part in a question and answer session. The question and answer session has proved a valuable opportunity for members and officers to engage with the operators outside the pressures of considering individual planning applications. For some LAs telecoms training for members has become an accepted component of on-going members training programmes.

The workshops are designed to assist LAs to address public concerns in their area and deal more efficiently and knowledgeably with applications for planning permission. The workshops also provide a forum for the local government audience to feedback to MOA and the operators their experiences of operator performance in the area of community consultation. It has been noticeable that, over the duration of the Commitment 4 programme, the attitude of elected members and planning officers has shifted and dialogue has become much more two-way and less confrontational. A comprehensive list of the Las, which have held workshops to date, can be viewed at:
http://www.mobilemastinfo.com/planning/mast_briefinghtm

As well as offering these workshops to LAs, each autumn for the past six years the operators have issued their annual network rollout plans to all LAs in England, Northern Ireland, Scotland and Wales. These plans contain information about the operators' existing radio base station sites and any envisaged network development proposals within the LA area for the following twelve months. For the past two years MOA has issued the operators' annual rollout plans to each LA jointly via email. In addition to sending the plans from a single source (MOA), the appropriate representatives at LAs are contacted and invited to arrange a joint meeting with all of the operators to discuss the plans.

As with the Commitment 4 workshops, annual rollout plan meetings have provided a unique opportunity to allow LAs direct access to current and future radio base station site development for all of the operators. These meetings have provided unparalleled one-on-one interaction with regional operator representatives and have been a major step forward in operators' communications with LAs. LAs are also encouraged to use the annual rollout plan information to assist in their own community consultation and to update their mast register if they have one (something which is encouraged by central government guidance). Several LAs have found it useful to create a mast register to actively engage community members and to monitor mobile phone network development in their area.

In the autumn of 2006 the operators' annual rollout plans, accompanied by a covering explanatory letter, were e-mailed to all LAs and National Park Authorities in England, Wales, Scotland and Northern Ireland. The number of LAs which requested a joint operator meeting in 2006/2007 increased by 50% in comparison to the 2005/2006 period. As in the previous year, in December 2006 a follow-up questionnaire form was e-mailed to gauge the response of the LAs to the method and content of the annual rollout plan submissions. This elicited a 36% response rate with 155 LAs responding (which equated to

twice as many compared to the previous year). LAs received the annual rollout plans positively with 85% of respondents stating that the information either met or exceeded their expectations.

Additionally, for the past six years leading UK market research firm Ipsos-MORI has conducted research on behalf of MOA on an annual basis to measure LA planners' satisfaction with the operators' interaction with them on mobile telecommunications network development. Results from the 2006 market research include:

- Four in five local authority planners agreed that there had been an improvement in the quality of information and level of consultation. One in five 'strongly agreed', almost three times as many as did so in 2005
- Just over four in five agreed that the operators made themselves available for discussion with planners before submitting applications, and though fewer (70%) agreed the operators also showed willingness to consult local people directly; this had increased since 2001 when only 8% said the same
- Seven in eight respondents felt the operators co-operated positively with requests for more information about planning applications

The Ipsos-MORI report may be viewed at:
http://www.mobilemastinfo.com/planning/intro.htm

Whilst there are still improvements to be made, the results of the Ipsos-MORI research over the past six years clearly demonstrates that a proactive programme of stakeholder engagement incorporating multiple issues has proven to be an effective method by which to directly address local government political audiences. Ongoing development of the programme incorporates feedback from LAs, and aims to continue to address current RF health, town planning, and telecommunications issues. The MOA programme of telecom training workshops for Las and joint annual rollout meetings will continue into 2007/2008.

**Annual Party Conferences – engaging with national political audiences**

In 2005 the MOA sought to place into context the way in which the RF health issue has been dealt with in the UK media. The MOA engaged an independent London think tank, the Social Market Foundation (SMF), to conduct a series of debates at the annual conferences of Britain's three major political parties (Labour, Conservative, and Liberal Democrat) to explore the topic: "*Science, Risk and the Media – do the front pages reflect reality*?"

Chaired by the SMF, panel speakers were drawn from the political spectrum, science, the medical profession, the media, and industry. The debates considered how policy makers can better engage with the public and the media on scientific and technological issues. In the Foreword to a booklet published by the Social Market Foundation following the 2005 debate, Lord Dick Taverne, Chair of the charity Sense About Science, wrote:

"*The interesting discussions below include certain common themes: that there is a mood of suspicion towards science and experts, that scientists are generally bad at getting the public to understand their work and that have little knowledge of science and love a good scare story……Restoring confidence in science will not happen suddenly by gimmicky solutions, such as having 'the public' decide what is worthwhile research, or treating lay*

*opinion as just as valuable as that of experts. As the following discussions more or less illustrate, openness and honesty provide the key to trust*."
http://www.smf.co.uk/index.php?op=modload&name=UpDownload&req=viewdownloaddetails&lid=157

Several themes emerged from the debates. Ipsos-MORI market research polling shows that 71% of the British public believe that the media sensationalise science and, when the media gets it wrong, the consequences can be serious, e.g. following extensive media coverage of the MMR inoculation issue (when one research paper had suggested a causal link between MMR inoculation and autism) inoculation rates fell by 20% putting children's lives at risk. The point was made that a problem arises when the story moves from the science pages of a newspaper to the political pages thus portraying the players in the issue as 'villains' and 'good guys', which removes the debate from the arena of science to politics where a completely different set of rules applies. This is what happened with the MMR inoculation debate. It was pointed out that the British public is "addicted to risk" and worries about new technology, and is easily swayed by anecdote, which has nothing to do with science itself.

In Britain during the past decade public confidence in science has seriously declined and this has given rise to a self-sustaining scepticism, which devalues science and scientists. Policy makers need to champion scientists in order to retain them. In turn, scientists need to engage in public debate and be challenged by ministers where necessary. However, scientists are professionals whose role is to advise, they are not policy makers. It was agreed that the media has an obligation to provide a balanced view for its audiences, although this often does not happen. There appears to be a continuing gap between what the media reports and what scientists are saying. Editorial policy can be responsible for misleading science stories, and headlines by sub-editors can change entirely the thrust of a story. Accurate communication on science issues is very important for society. In Britain the Science Media Centre (www.sciencemediacentre.org) has proved to be an invaluable resource to both the scientific community and the media during the past five years. The importance of peer review was also mentioned. In this regard, Sense About Science in London has published an excellent booklet on the subject:
http://www.senseaboutscience.org.uk/index.php/site/project/29/

In 2006 a similar fringe meeting programme was undertaken at the three major political party annual conferences with the topic: "*Science Fact or Science Fiction: How should politicians respond to media scare stories?*" Again, chaired by the SMF, panel speakers were drawn from the political spectrum, science, the medical profession, the media, and industry. On this occasion, the debates considered how politicians should respond to media scare stories.

A politician warned of an escalation in what he described as a war between Science and media propagated anti-science. He called on politicians to side with science and not the media, saying that they should know better than to be opportunistic. Specifically, he criticised local campaigners for advancing what he described as "scientific nonsense" in relation to issues such as mobile phone masts. He also criticised MPs for signing early day motions in Parliament that were in direct conflict with each other, e.g. on animal research. He pointed out that there were problems in the perception of truth. Politicians and journalists always want to know if something is 'safe' whilst science can only state

that there is no evidence of harm, i.e. it is impossible to prove a negative. In addition, there is a failure to understand the difference between hazard and risk.

A science journalist for a UK daily newspaper said that the media does not treat Science in isolation from other news stories and its coverage, at least in part, is driven by its readership. He acknowledged that the media is sometimes guilty of oversimplification and inflating an issue based on limited science and then failing to publish corrections when subsequent science demonstrates that such an approach was not justified. Sadly, science, which moves forward incrementally, does not fit in well with a fast moving daily news agenda. On the issue of politicians and the media, he asserted that politicians and policy makers need to be absolutely straight with the public and he gave the BSE crisis in Britain as an example of how great damage had been done to science by failing to go down this route.

A Government Minister said that the British Government approach had changed from one on the public understanding of science to one on the public engagement of science. He said it is important that people become part of an open and transparent process in relation to scientific issues. He argued that scientists must play a major proactive role as advisors to government – they should not keep their heads down until issues blow over. He made the point that the MMR inoculation issue in Britain had gone wrong when it became a political story rather a science story.

A prominent UK academic and former senior government official continued this theme. He said that, in addition, there is dishonest reporting in the some parts of the media, which can be fuelled by the public's liking for stories involving sex, money, death, and conspiracy. He gave the example of journalists being 34,000 times more interested in measles deaths than smoking related deaths. The problem can be compounded by the lack of scientific knowledge by some journalists. However, he readily conceded that politicians and policy makers must engage with the media and the public on scientific issues. Openness and transparency is very important. He also emphasized the importance of trust when communicating with the public.

In many ways the 2006 debates mirrored and extended the 2005 debates with many common themes. The MOA was represented on each of the debate panels by its Executive Director who used the RF health issue as a case study for many of the points made by other speakers. The importance of this was that it enabled the debate audiences to view the RF health debate as part of a much larger picture involving the media and public perception of risk and not to view it in isolation. This was a step forward in seeking to raise the maturity of the political debate about the RF health issue. Too often, those stakeholders involved in the RF health issue debate at the coalface understandably forget that similar debates are taking place across society in a variety of issues and that it is important to keep sight of the big picture.

**Ongoing political engagement – local and national**

The MOA also has an ongoing engagement programme with UK Members of Parliament (MPs), Members of the Scottish Parliament (MSPs), and Members of the Welsh National Assembly (AMs) to address any concerns they may raise on behalf of their constituents relating to mobile phone network development. The MOA also meets with officials and ministers in the UK Government, particularly with the Department for Communities and

Local Government, the Department of Trade and Industry and the Department of Health. This engagement programme is replicated with the Scottish Executive and Welsh Assembly Government.

The overall aim of the MOA's engagement with MPs, MSPs and AMs is to improve the understanding amongst elected members of the way in which the operators develop their mobile networks, the regulatory environment in which the networks are developed, and to address any concerns regarding RF health and safety. The MOA also seeks to meet with all MPs, MSPs and AMs who express concerns regarding mobile telecommunications planning policy or RF health and safety. There are a number of ways in which these concerns can be raised in Parliament. For example, an individual MP can have published in the official record of Parliamentary proceedings ("Hansard") an Early Day Motion (EDM). An EDM enables the MP to publicise his or her concern or support for any issue, which can then be signed by any other MP.

In recent years, there have been several EDMs in the UK Parliament that have raised concerns regarding both the telecoms planning system and the safety of the mobile networks. Each MP who signs an EDM is provided with a briefing paper by MOA and offered a meeting to discuss the issues in more detail. A copy of the briefing on the EDM is also provided to Government officials who may need to supply information to their minister.

Other ways available for MPs to bring issues to the attention of Parliament and the Government are Parliamentary Questions (either written or oral) and through sponsoring 'private members bills' which are then given Parliamentary time for debate on the subject concerned. Whenever any of these mechanisms are used to address the issue of mobile telecommunications network development or the related RF health and safety issue, the MOA writes to the MP(s) with a short briefing on the issue and attempts to arrange a meeting with them to discuss their concerns. In addition to this reactive engagement programme, the MOA also actively seeks meetings with MPs, MSPs and AMs to discuss these issues more generally.

In the past two years, the MOA has held a 'drop-in' meeting in the UK House of Commons, which is open to all MPs and their staff. These sessions last for around three hours and enable MPs to attend at a time of their choosing to discuss general issues regarding RF health and safety or mobile network development. MPs also have the opportunity to discuss directly with representatives of the operators issues that are specific to their constituency. The most recent meeting was held on 18 April 2007 and was attended by seven MPs and three staff. Despite the small numbers attending, the MOA regards it as important to be available to MPs and their staff to respond to enquiries on mobile network development issues. Similar meetings have been held in the Scottish Parliament and in 2007 are being organised for AMs in the Welsh National Assembly building in Cardiff.

In 2006, the MOA published a newsletter for the first time. This newsletter is aimed at MPs, MSPs and AMs and provides up to date information on network development, town planning and RF health and safety issues. The newsletter is published twice yearly and future issues will also be sent to all local authority councillors in the UK. In July 2006, the MOA arranged the first in a series of joint meetings with three UK Government ministers with responsibility for public health, town planning and telecommunications issues. The

aim of this joint ministerial meeting was to encourage a more integrated approach to the RF health issue and related town planning issues. The provision of public information on both the planning system and the RF health and safety was discussed and a further meeting with ministers was held in December 2006. From these meetings, agreement was reached on a number of initiatives that both Government and industry could undertake to improve the provision of information for the public and their elected representatives (MPs and councillors) on the RF health issue and mobile telecoms network development issues.

In addition to ministerial meetings, the MOA holds regular meetings with Government officials. These cover general topics related to the RF health issue and network town planning issues as well as specific initiatives, particularly those arising from ministerial meetings. This direct engagement with Government officials and ministers is crucial to ensure understanding across departments on the issues within the MOA's remit. Meetings with ministers have been replicated with opposition spokespeople on planning, health and science and technology issues. Again, these meetings are crucial in updating key MPs with RF health and safety information as well as network development issues.

**Conclusion**

Political audiences at both national and local government levels in the UK are key stakeholders in discussions regarding the RF health issue and mobile network development issues. As representatives of the public, politicians need to be engaged in an open and transparent dialogue to ensure that they have access to current and objective information about these issues. It is also important that these issues are viewed in the wider societal context of risk assessment and risk communication.

During the past six years, MOA's programmes of communication with political audiences in the UK have formed a key element in its overall communications efforts. These will continue in place.

# Education

## Mobile Communication and Children: A Risk Communication Challenge

N. Leitgeb
Institute of Clinical Engineering, Graz University of Technology

### Background

Since its introduction in 1994 mobile telecommunication technologies have become a triumphal success story with a previously unknown speed of market penetration. However, apart from their obvious benefits there is also fear whether exposure to the emitted electromagnetic fields might be a potential health risk. In the recent years the use of mobile phones by children has been increasing with the onset of use shifting towards ever-younger ages. This lead to concerns whether children might be at higher risk and whether mobile phone use should be forbidden to them.

In this situation, advice is needed to properly inform parents, teachers and children. However, recommendations given on national and international levels turned out to be contradictory. It is interesting to note that quite different conclusions are drawn from a common database. Unfortunately, contradictory recommendations are more confusing than guiding and may challenge credibility in reputed organisations, however, this can be explained.

### Scientific positions

The issue became hot in the year 2000 when the British Independent Expert Group on Mobile Phones (IEGMP) issued a report on potential mobile phone health risks arguing "There is evidence that at frequencies used in mobile phone technology, children will absorb more energy per kilogram of body weight from an external electromagnetic field than adults" and concluding "the widespread use of mobile phone by children for non-essential calls should be discouraged" [8]. In 2001 this was reaffirmed by a French expert commission [13] stating "There is no scientific data establishing any risks due to long-term exposure in adults or children, but neither is it possible to eliminate that possibility". For this reason the expert group suggested "that parents who feel it necessary to equip their children with mobile phones should ensure that they make reasonable use of this equipment." In 2004, the British National Radiation Protection Board (NRPB) reconfirmed *Stewart's* conclusion by stating "… in the absence of new scientific evidence the recommendation of the Stewart Report on limiting the use of mobile phones by children remains appropriate as precautionary measure" [6].

The group of precautious statements is contrasted by reassuring positions of other institutions. The Health Council of The Netherlands came to the conclusion "… that there is no health-based reason for limiting the use of mobile phones by children" [3]. A similar position was taken by the United States Food and Drug Administration, which concluded "… the scientific evidence does not show a danger to users of wireless communication devices including children" [2]. WHO reassured by saying "present scientific information does not indicate the need for any special precautions for use of mobile phones" but left room for individual judgement conceding that "if individuals are concerned, they may choose to limit … their children's RF exposure" [11]. In 2005 WHO reconfirmed this

statement in a clarification statement [10]. This position was adopted by several other authorities such as Australia's ARPANSA.

In Austria, in December 2005, the Vienna Medical Association issued an alarming leaflet warning, "mobile phone use might not be as harmless as claimed by the providers" and recommending, "children below 16 years should best not use them at all" [9]. This was prompted by a more moderate recommendation of the Austrian supreme medical counsel recommending a rational use of mobile phones and reduction of exposures in particular of children by observing some hints such as to prefer headsets and keep use short [7].

In view of such controversial positions of highly reputed organisations, it is not surprising that confusion is widespread and parents can hardly decide whom to believe and whether or not their children might be at higher risk.

**Risk Communication**

In regard to risk communication, the different messages although correct can be explained by two major aspects:

- On the one hand, the term "children" is left unclear. In fact, in national regulations "childhood" is defined differently, up to an age of 14 or even up to 19 years. However, scientific concern concentrates on children below 6 years or even 2 years.
- On the other hand, the messages differently acknowledge uncertainties because they were based on different levels of evidence. The physical nature of electromagnetic fields, the quantum energies, and the physical laws ruling their propagation and interaction with substances are well known. Based on the existing knowledge the absorption of electromagnetic energy causes mechanical movement of particles and molecules, which is converted into heat. Based on the known body of potential interaction mechanisms and due to the small quantum energies relevant non-thermal effects such as molecular changes due to quantum absorption can be ruled out. So far, established biological responses including auditory effects caused by short intense pulses can be explained by thermal mechanisms.

Below the existing limits there is no established interaction mechanism that could explain accumulations of small lasting changes with time, which are characteristic for dose-dependent effects such as of x-rays. Therefore, if long-term effects are postulated, they necessarily need to be based on hypothetical mechanisms other than temperature changes. Therefore, the assumption of relevant non-thermal effects needs to be based on speculations on yet unknown mechanisms. Due to the inconsistencies and lack of replication it cannot be concluded whether a genotoxic in-vitro effect really exist and if so, whether it can be extrapolated to living organisms and if so, to humans, and if so, whether it would be relevant to health. However, the existence of a genotoxic effect would have a considerably impact on health risk assessment. Therefore, the major question is whether long term effects, caused by whatever mechanism, can be ruled out with convincing certainty or not.

**Special role of children**

Apart from emotional aspects children are considered to deserve more critical attention and a more conservative approach in risk assessment [5]. This is because of following circumstances:

(a) It is already a legal principle that "children" cannot be considered fully responsible for their actions and, hence, it cannot be relied upon that they will be compliant with given advice. Therefore, protection needs to rely on other means.

(b) Although children's cells might not exhibit an increased vulnerability, children may be more susceptible (also) to EMF interaction because of different reasons:

- Cell division rates are higher in children's developing organism. This leads to increased probability of the presence of cell cycle phases vulnerable to external factors. This is the reason why probability of adverse effects is higher compared to adults. This is particularly important in regard to the discussion on potential genotoxic effects.
- Both regulatory and immune systems are still developing in children. This could lead less efficient responses to adverse external factors.

(c) Children brains may be more exposed to mobile phone EMF radiation because of

- The smaller distance of the headset to the brain because of, 1) the more flexible ear (which allows a closer position) and, 2) the smaller thickness of the skull;
- Unfavourable attitudes how to use mobile phones;
- A higher absorption ability of their brain tissue because of the unfavourable influence of its higher water content;
- A more extended exposure of children brains because of their smaller head size relative to the RF-EMF penetration depth.

(d) Children may accumulate a higher lifetime exposure compared to adults. It is a fact that children use mobile phones earlier and, hence, accumulate a longer lifetime exposure. The judgement whether this leads to an increased risk depends on whether there is a probability for accumulative RF-EMF effects. If such effects would occur, this would increase the risk for potential long-term effects compared to adults.

**Long-term effects**

The knowledge on established interaction mechanisms does not support the hypothesis of accumulative effects and laboratory, and epidemiologic studies are inconclusive. However, whether term effects exist is a key question. In regard to it the positions of international organisations are cautious in not ruling out this possibility. In particular, WHO concluded [11] "… the (mobile phone) technology is too recent to rule out possible long term effects." ICNIRP [4] states that "… the available data are insufficient to provide a basis for setting exposure restrictions", but it does not rule out this possibility either. In the EU directive on occupational EMF exposure the wording is even stronger. It is made clear that occupational limits protect from known adverse short-term effects [1] "… but not from *assumed* long term effects". These positions make clear that the possibility of long-term effects of yet unknown mechanisms is not ruled out by most important organisations.

It is an ongoing debate on the role precaution should play. Experience shows that precautionary recommendations can be counterproductive [12]. They can enhance perceived risk and raise disproportionate fear, which in turn can have even more relevant adverse health implications. This is the reason, why radiation protection committees have to do a tightrope walk in risk communication. In restricting themselves to established effects only, the conclusions are clear and calming but committees who advocate for precaution are not in conflict with such statements. They simply extend the basis of their judgement and also account for different degrees of uncertainty of knowledge.

A balanced view has to acknowledge the existing uncertainty and to restrict to such precautionary actions that keep a reasonable balance to the expected benefits. According to statements of the EU Commission and WHO, full risk assessment should not focus on risks of use only but also include risks of prohibited use. Therefore, it is necessary to put warnings into perspective to the magnitude of hazards of use and non-use, and to keep the sense of proportion. It should be kept in mind that already established every day life's risks to children such as UV-exposure or passive smoking are usually higher and much more established, and would merit even more attention. Overreacting and alarming warnings from low risks could be counterproductive and degrade perception of higher risks and undermine acceptance to protect from them.

**Conclusion**

There are no sufficient grounds to generally condemn mobile phone use by children in particular there is no established basis to pinpoint a specific age limit (above 3years) as some overreacting committees have done it.

The body of evidence and international health risk assessment do not challenge existing exposure limits. However, in regard to long-term effects there is some uncertainty remaining. If long-term effects would exist, children need to be considered to be at relatively higher risk than adults. Therefore, it is reasonable recommending that justification for use should be stricter the younger children are. Consequently, if advice is given to adults to minimise exposure, it is even more justified for children. However, circular reasoning must be avoided. The uncertainty-triggered application of the precautionary principle must not be misinterpreted as evidence for certainty of risk.

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## Bavarian School Project with SAR-Measurement Heads

H. Eder, Bavarian Environment Agency
E. Vogel, Bavarian Ministry of the Environment, Public Health and Consumer Protection

### Introduction

In 2005 the Bavarian Environment Agency, an Agency of the Bavarian Environmental Ministry, started a project for schools to improve the knowledge of pupils in the biological and physical basics of mobile telephony. Additionally responsible use of mobile phones in society is to be promoted and problems like debts due to high phone bills are discussed.

For the project the Bavarian Environment Agency acquired 10 sets of measurement equipment, consisting of a so-called SAR-measurement head and an attached notebook with analysing software. The age range of the target group is about 15-18 years. By the end of 2007, preparatory courses for more than 460 teachers have been held in more than 20 Bavarian cities and about 20000 pupils have used the measurement equipment in class. In this short report we describe the project's development and implementation, and present a summary evaluation of its objectives and results.

### Project's description and purpose

The Bavarian Environment Agency prepared ten measurement kits each including a SAR measurement head, an attached notebook with software to analyse measurement data and protocols on how to set up experiments. The cost of one of these kits is about 8000 Euros.

The measurement head is filled with tissue equivalent liquid and measures the specific absorbed radiation (SAR) in different situations. Online the notebook shows a graphic analysis of the measurements. A comparison with calibrated professional equipment showed good compliance. Figure 1 shows a standard measurement kit including a SAR-measurement head, an attached computer notebook with software (left). And on the right an example of an experimental set up: The effect of shielded high frequency radiation (i.e. a bad connection to the next mobile phone station due to the metal net) on radiation strength of the phone (i.e. the SAR in the head) is demonstrated.

The range of possible experiments include the measurement of:

- The dependency of the SAR on the quality of the connection
- The typical stand-by mode, DTX situations
- SAR of different mobile phones, WLAN and DECT
- Quality of different shielding
- Influence of headsets
- Location of the integrated antenna in the phone

In order to enable a smooth working, at least one teacher of a school interested in getting the measurement equipment has to come to a preparatory course first. During this course the equipment and the possibilities for experiments are explained. Then the school may borrow a measurement kit for 1-2 weeks and use it in different classes or for open house

events. The age range of the target group is about 15-18 years, but usually also parents and other teachers are very interested in the measurements.


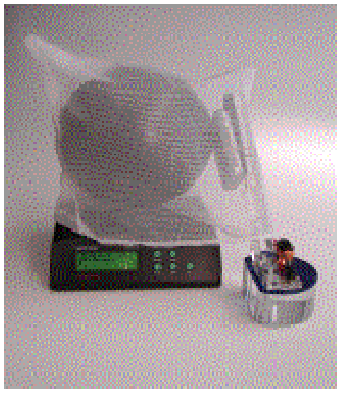

Figure 1. Left: Standard measurement kit including a SAR- measurement head, an attached computer notebook with software. Right: Example of an experimental set up.

Meanwhile the accompanying brochure "Cool Tips for Handy Kids" was devised and printed by the Bavarian Environment Agency. It is handed out in schools and contains tips for a safe and reasonable use of mobile phones in daily life. The Internet page www.mobilfunkundschule.bayern.de provides additional information material and power point presentations on the basic physics and biology of mobile telephony. The booking form and the booking calendar are also on the Internet.

**Initial results and future prospects**

By then end of 2007 preparatory courses for about 460 teachers were held in more than 20 Bavarian cities and about 20000 pupils used the measurement equipment in class. The equipment has also been used for more extensive projects, and small research projects by pupils ("Facharbeiten" and "Jugend forscht").

Although the equipment is regularly packed and sent around very little damage occurred and only few repairs had to be made. The equipment will be adapted to new high frequency applications like WiMAX. At the moment it is mostly used in schools leading to the baccalaureate, but use in different types of schools is considered, meaning that the accompanying material has to be revised and adapted.

*Further information:*

The internet page: www.mobilfunkundschule.bayern.de contains all the information about this project, including a brochure designed for children, power point presentations and a calendar to order the equipment. All the material can be downloaded and the reservations for the schools can also be made on this site.

For more details contact the authors:

heinrich.eder@lfu.bayen.de
evi.vogel@stmugv.bayern.de

## With Educational Projects to Better Evidence Based Politics and More Self-responsibility

Mirjana Moser, and Salome Ryf
Federal Office of Public Health, Switzerland

### Introduction

In risk communication as well as in educational projects there are specific target groups, who need specific information and knowledge in order to fulfil their specific tasks. In the following contribution two such examples are presented aiming to get:

- Better evidence-based politics
- More self-responsibility

Target groups, particular knowledge needed by the target groups and ways to disseminate this knowledge are outlined. In both cases, presented items and suggestions are neither complete, nor systematic, but are intended to give some inputs and challenge further discussions.

### Better evidence based politics

*Who is considered?*

Evidence based politics means politics based on solid scientific evidence. This simple, plausible statement is not that simple in the area of electromagnetic fields (EMF) where a high level of uncertainty in scientific evidence is present and where the matter is complex and hard to understand. It is therefore necessary, that decision makers in the area of EMF, besides the basics of physical, biological and health issues, do have some additional, supplementary knowledge, which should enable them to act in a reasoned, evidence based way, even in the absence of clear evidence.

Target groups include in the first place decision- and policy-makers like:

- Politicians
- Authorities
- Stakeholders who take part in the decision- and policy-making process.

Mediators, who are supposed to understand decision processes and transfer the corresponding information, also need the same knowledge. Those target groups might be:

- Educational institutions
- Media

*Need for specific knowledge*

Specific knowledge, which the target group needs in order to fulfil its tasks in the frame of evidence based politics, is focused around the following three points.

- Understand research results and their weight of evidence. In order to understand scientific evidence, it is necessary to understand research results AND criteria for scientific evidence like causality criteria for health effects. Out of this knowledge it should, for

example, be clear why a decision, based on one single study, can not be regarded as "evidence based" and why sophisticated research evaluations of many different studies are needed. Basic philosophies and a background for the evaluation of research results should be outlined, as done by IARC, WHO or ICNIRP. Scales for weight of evidence, like the one of IARC for carcinogenic effects, are very useful for judging and comparing health effects and their weight of evidence.

- Put research results, inclusive their weight of evidence into a socio-political context. In order to make decisions on risk-management, results of research evaluations, inclusive weight of evidence, have to be put into a socio-political context. This means that the consequences for public health, for the environment, for technical development etc. have to be estimated. Some rudimental risk - benefit analysis should be conducted and the level for an acceptable risk has to be defined. Possible measures for protection, prevention or precaution could be proposed and their costs outlined. Research results, always including weight of evidence, should be presented in a way that is most suitable to conduct the above-mentioned estimations. One example: research results on health effects are mainly published as relative risks, but for decision makers, in order to judge the consequences for public health, risk differences would be more suitable.

- Know the legal frame and possibilities to act in the situations with uncertainties. With the knowledge gained from the previous two points, decisions can be made in a given legislation and institutional frames. These frames and possibilities to act, especially in the situations with uncertainties, have to be communicated together with the underlying philosophy. For example sustainability is one of the main principles in the environmental protection. Risks that might cause some irreversible changes in the environment are therefore treated more precautionary, even for low weight of evidence. Another example is product safety where, considering health protection, self-responsibility and information of consumers play a very important role.

*How to disseminate the knowledge?*
In order to reach the target group all these information should be put together and imbedded in the documents anyhow designated to the same target group like:

- Reports
- Answers to political questions and initiatives
- Dedicated workshops

Language has to be adapted to be understood by the target group, free from too technical terminologies.

## More self-responsibility

*Who is considered?*
While in the previous chapter the target group have to decide on global issues in the frame of risk management, this chapter deals with situations, where an individual has to discern its self-responsibility and act in an appropriate way. Considered are:

- Consumers, users of EMF apparatus, individuals
- Authorities and organisations responsible for information and advising
- Mediators (consumer organisations, medical doctors).

*Need for specific knowledge*

To understand why and where EMF sources are. Knowledge of the sources, and generation and applications of EMF is needed in order to estimate personal benefits, to realise whether there are alternatives or not.

To have an idea of the risks AND uncertainties. Some basic knowledge on risks and uncertainties and on level of evidence are needed in order to estimate personal risk acceptability and, together with the previous point, personal risk-benefit balance. At that point also indirect risks connected with electromagnetic compatibility should be communicated.

- Know what is regulated and where the self-responsibility starts

It should be clear to what level the risks are “under control” (legally regulated) and from what point the self-responsibility starts.

- Know what measures can be taken to reduce or avoid exposure

Measures, which might be taken individually, should be listed; starting from measures to reduce, minimize or avoid exposure, shielding possibilities, or alternatives if there are any.

*How to disseminate the knowledge?*

Target groups consist of individuals and are very heterogeneous. Therefore, the information channels based on a kind of “self-service” information dissemination, like Internet, or other channels based not on the “bring”, but on the “get” principle, like magazines, are most appropriate. The most appropriate, but also the most time-consuming are of course direct contacts. Putting together, the possible dissemination channels are:

- Websites on internet
- Fact-sheets
- Publications in specialized magazines (consumer, patient, medical)
- Presentations on advanced training or workshops for “mediators”
- Direct contacts (from authorities or mediators to individuals).

**Examples**

The issues presented above are neither new nor unknown [1]. The elements, mentioned in the chapters on "knowledge needed", are indeed implemented in different information materials, but in many of them the aim of the information and the target population are not defined. The offered information is therefore not optimal and not appropriate for individuals and groups receiving them. Often the information are hidden and dispersed in a document and have to be extracted out of huge amount of information difficult to understand for the target population. Therefore; the reason to treat the issue in the present contribution is to increase the awareness of the need to clearly define the aim of the information and the target population.

In the two reports published in the last year by the Federal Office of Public Health (FOPH) in Switzerland [2], as well as in the corresponding answers on the questions from parliament, the issues were treated more consciously following the above presented items. The reactions on the documents show that the chosen information concept is appropriate, but there is still some room for improvements.

A number of fact-sheets, especially devoted to individuals in the general population, have been published on the website of the FOPH [2] (presentation by Salome Ryf on the

Workshop). The reactions on the fact-sheets are very positive, showing that we are on the right way, but also here there is still some room for improvements.

**References**

1. WHO: “Establishing a Dialogue on Risks from Electromagnetic Fields”, Geneva 2002

2. Federal Office of Public Health: http://www.bag.admin.ch/EMF:
- Report: “Nonionizing Radiation and Health Protection in Switzerland (German. French and Italian)” (2006),
- Report: “Risk potential from Wireless Networks (German. French and Italian)” 2007
- Fact-sheets (available also in English)

## Advanced Training for Physicians: Mobile Communication and Health
## Certified Advanced Training Series for Physicians, Psychologists and Public Health Service Employees

Dagmar Wiebusch and Fritz Lauer
IZMF, Informationszentrum Mobilfunk e.V., Germany

**Abstract**
Even for experts it is sometimes difficult to keep track of the current research and differentiate serious results from speculation. Particularly physicians must have access to up-to-date scientific knowledge in case their patients attribute their health concerns to the electromagnetic fields (EMF) of mobile communication. In order to provide an overview of the current state of research, the Information Centre Mobile Communication e. V. (IZFM) offers a certified 'Advanced Training for Physicians' and related professionals. During the 2 ½ hours training, the participants get familiarized with physical characteristics of EMF and their effects in the areas of biology, epidemiology and environmental medicine.

Independent scientific experts, covering the topics, present three scientific lectures:

- Spread and effects of EMF
- Biological effects below the safety margins
- Doctor - patient communication

The courses are approved based on the advanced training guidelines of the state medical associations in Germany and count 5 CME points towards the voluntary Advanced Training Certificate.

**Background**
International und national experts assume that, based on the current level of knowledge, no health-related effects are caused by high frequency electromagnetic fields (EMF) emitted by mobile communication below the safety margins. However, isolated studies showing supposed health risks continue to spark public concern. Even for experts it is sometimes difficult to keep track of the latest research and differentiate serious results from speculation. Particularly physicians must be aware of current scientific knowledge in case their patients attribute their health concerns to the EMF of mobile communication.

**Objective**
In order to provide a non-biased and comprehensive overview of the current state of research, the Information Centre Mobile Communication e. V. (IZMF) offers a certified 'Advanced Training for Physicians' and related professionals. By means of the training, the participants get familiarized with physical characteristics of EMF and their effects in the areas of biology, epidemiology and environmental medicine. They also receive insight into the practical experiences of an environmental ambulance when dealing with concerned patients. The results of the Interphone Study, sponsored by the World Health Organization (WHO), and the German Mobile Communication Research Program, initiated by the Federal Agency of Radiation Protection, are presented. Studies of experiential

medicine and their scientific validity are illustrated and discussed. After the presentations, the participants will practice with case studies concerning complaints related to the so-called 'electromagnetic hypersensitivity'.

**Methods**

The 'Advanced Training for Physicians' lasts 2 ½ hours. After an introduction by a moderator from the IZMF, independent scientific experts present three scientific lectures of 20 minutes, followed by discussion. After a break, the participants are divided into small groups to study case histories of patients and their environment attributed problems. Aspects of their medical history and multidisciplinary diagnostic approaches are examined and environmental evaluations and recommendations for these patients are discussed. Finally, the participants test their newly acquired knowledge by completing questionnaires at the end of the course.

The lectures are divided into three main topics:

*A. Spread and effects of electromagnetic fields*

Participants are introduced into EMF basics; existing knowledge is supplemented. The following questions are of special interest:

- Radiation spectrum – Where does mobile telecommunication fit in?
- Low frequency/high frequency – What are the differences?
- Biological effects of high-frequency EMF – What is proven, what is not?
- Safety margins – How are they determined and who establishes them?

*B. Biological effects below the safety margins - This is what research says*

Thermal effects of high-frequency fields (thermal efficiency) are scientifically well proven. Therefore the non-thermal biological effects are especially focused, since they are often discussed controversial:

- Which research has been completed in the past?
- Which are the main results on biological EMF effects?
- Which kinds of research programs are in progress?
- Which results are already available, which questions are still open?
- Which trends can be seen in currently conducted studies?

*C. Doctor-patient communication – Mobile telecommunication in medical practice*

Main topic is recommendations for daily practice, including scientific facts. The shortcomings of so-called 'popular' studies, well known by many patients, are also discussed. The opportunities and limits of reasonable prevention are demonstrated.
The following questions are considered in some detail:

- Environment related well being disorders - What is their cause, how can they be evaluated?
- 'Electro-sensitivity' – What does science say, how do physicians deal with it?
- Problems and shortcomings of popular scientific studies
- Opponent movements of physicians
- Prevention: What is necessary, what is reasonable?

*Course Instructors*
Renowned and respected instructors who work for a long time in EMF-research and monitoring give the lectures. Most of them are members of EMF-task forces of the German Commission on Radiological Protection or other relevant advisory boards (Spread and effects of electromagnetic fields: Charity Kinderumwelt GmbH, Osnabrück and Institute for Occupational and Environmental Medicine, Ludwig-Maximilians-University, Munich; Biological effects below the safety margins – this is what the research says: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, Jacobs University, Bremen and German Cancer Research Centre, Heidelberg; Doctor-patient communication – mobile telecommunication in medical practice: Institute for Hygiene and Environmental Medicine, Justus-Liebig-University, Giessen).

*Scientific Administration*
Prof. Dr. med. Thomas Eikmann and Prof. Dr. med. Caroline Herr from the Institute for Hygiene and Environmental Medicine, University Giessen as well as Prof. Dr. med. Karl Ernst von Mühlendahl, Director of the charity Kinderumwelt GmbH are responsible for the scientific supervision of the advanced training courses.

*Certification*
The Advanced Training Series has been approved by the state medical associations of Baden-Wuerttemberg, Bavaria, Brandenburg, Hesse, Lower Saxony, Rhineland-Palatinate and Thuringia . They count five Continuing Medical Education (CME) points towards the voluntary Advanced Training Certificate.

**Conclusion**
Approximately 300 participants have attended the advanced Training Series since 2005. The evaluation questionnaires show that the majority of participants consider the Training Series to be positive. It is a suitable tool to communicate knowledge about the health effects of EMF to physicians and health-related professionals. It leads them to a better handling of worried patients.

# Measurements

# Management of the Social and Environmental Impact of Electromagnetic Fields in Italy

Mario Frullone, Doriana Guiducci
Fondazione Ugo Bordoni, Villa Griffone, 40037 Pontecchio Marconi (BO), Italy

**Abstract**
The paper describes the approach followed by the Italian Government in the management of the electromagnetic issues. In particular the Italian national Electromagnetic Field (EMF) monitoring network, that the Ministry of Communications established with the technical support of Fondazione Ugo Bordoni (FUB) and in collaboration with the local Environmental Protection Agencies of all Italian Regions is presented. Besides the monitoring activity on the territory, a brief overview of the supporting communication campaign is also given.

## 1. Rationale for building the EMF monitoring network

Mobile telephony is now commonplace around the world. This wireless technology relies upon an extensive network of fixed antennas, or base stations, relaying information with radio-frequency (RF) signals.

Some people perceive risks from RF exposure as likely and even possibly severe. Several reasons for public fear include media announcements of new and unconfirmed “scientific” studies, leading to a feeling of uncertainty and a perception that there may be unknown or undiscovered hazards. Other factors are aesthetic concerns and a feeling of a lack of control or input to the process of determining the location of new base stations.

In Italy, more than in other European Countries, anxiety and fears have arisen and, all over the Country, demonstrations of protest against antennas or cellular base stations installation were organised by independent groups of citizens. In response to the public worry and the diffused risk perception, the Italian Government took some actions both at operative and communicational level.

The Italian Ministry of Communications established the national Electromagnetic Field monitoring network with the technical support of Fondazione Ugo Bordoni (FUB) and in collaboration with the local Environmental Protection Agencies of all Italian regions.
In the framework of the EMF monitoring network nearly 50 million samples have been collected and more than 7000 monitoring campaigns carried out. Therefore significant considerations and various results can be drawn from the analysis of the data.

The monitoring activity was accompanied by a communication campaign, in order to make the Italian public aware of the efforts that were being done to evaluate the actual exposure levels and of the results that these efforts produced. It was felt that the complexity of the issue, and the widespread worry (and sometimes open hostility) caused by the installation of new transmitting antennas, required thorough information campaigns to be carried out directly on the territory.

The campaign of communication was carried out by the Ministry of Communications with the support of Fondazione Ugo Bordoni and involved actions both at national and local level.

## 1.1 Regulatory framework

International and European Union regulations

Most of international regulations, as well as the European Council Recommendation 519/99 on exposure of the general public to electromagnetic fields (1999) [1], are essentially based on the guidelines formulated by the International Commission on Non-Ionising Radiation Protection (ICNIRP) [2], a non-governmental organisation formally recognised by the World Health Organization (WHO), which establish exposure limits by taking into account ascertained sanitary effects. For this reason, current limits do not consider possible long-term effects; however, ICNIRP is committed to revise the guidelines should new sanitary risk evidence appear, both for cancer causing effects and for other kinds of consequences.

The reference levels for exposure of the general public to time-varying electromagnetic fields proposed by ICNIRP, and accepted by the European Union, are shown in Table I.

**Table I. REFERENCE EXPOSURE LIMITS PROPOSED BY ICNIRP**

| **Frequency range** | **Electric field intensity (V/m)** (f is the frequency in the unit shown in the leftmost column) | **Magnetic induction (μT)** |
|---|---|---|
| Up to 1 Hz | - | $4*10^{4}$ |
| 1-8 Hz | 10,000 | $4*10 / f^{42}$ |
| 8-25 Hz | 10,000 | 5000/f |
| 0.025-0.8 kHz | 250/f | 5/f |
| 0.8-3 kHz | 250/f | 6.25 |
| 3-150 kHz | 87 | 6.25 |
| 0.15-1 MHz | 87 | 0.92/f |
| 1-10 MHz | 87/f ½ | 0.92/f |
| 10-400 MHz | 28 | 0.092 |
| 400-2000 MHz | 1.375 f ½ | 0.0046*f ½ |
| 2-300 GHz | 61 | 0.20 |

Coming to the European Union, so far no mandatory regulations have been adopted; there is however an indication that all Member States should adopt cautious measures, which should be as homogeneous as possible throughout the Union, but recognising the different (and generally more restrictive) regulations already in force in some Countries.

Italian regulations

The Italian regulator adopted a more cautious stance than most other Governments concerning electromagnetic field exposure, abiding by the already mentioned prudent avoidance principle, stating that it is advisable to avoid, or at least reduce as far as possible, exposure to an external agent when there are doubts about its innocuous nature.

The Italian regulatory framework on exposure to radio-frequency electromagnetic fields has been initially based on the Ministerial Decree issued on 10th September 1998, number

381. The regulatory body has been subsequently updated and completed after the issuing of the "Framework Act" (no. 36, 2001) and the related Actuation Decree (DPCM 8th July 2003). The "Framework Act" univocally establishes the main principles and the specific duties necessary for the protection of environment and of health of general public and workers.

**Table II. EXPOSURE LIMITS FOR GENERAL PUBLIC**

| Frequency (MHz) | RMS value of electric field (V/m) | RMS value of magnetic field (A/m) | Power density of the equivalent plane wave ($W/m^2$) |
|---|---|---|---|
| 0.1 ÷ 3 | 60 | 0.2 | - |
| > 3 ÷ 3000 | 20 | 0.05 | 1 |
| > 3000 ÷ 300000 | 40 | 0.01 | 4 |

The new regulation is based on a multi-level protection. The protection against acute sanitary effects is defined through **exposure limits** that are "values of electric, magnetic, and electromagnetic fields that shall never be exceeded in any exposure condition" (see Table II). For mobile phone frequency range the limit is 20 V/m.

• The protection against long-term effect is sought by defining the **attention thresholds**, i.e. "values of electric, magnetic, and electromagnetic field that shall not be exceeded in residential areas, schools and other environments where people may have a prolonged stay", namely a continuous sojourn for more than four hours (see Table III). The definition of a threshold equal to 6 V/m for the electric field is a consequence of applying a "caution factor" of 10 to the power density. Therefore the threshold is decreased from 1 $W/m^2$, corresponding to about 20 V/m for electric field, to 0.1 $W/m^2$, corresponding to about 6 V/m.

• The prudent avoidance approach, finally, implies the adoption of **quality targets**, i.e. "values of electric, magnetic, and electromagnetic field, emitted by any kind of equipment, that shall be attained in short, medium and long term even through available improvement procedures, aiming at health and environment protection also against possible long-term effects" (see Table III).

**Table III. ATTENTION THRESHOLDS AND QUALITY TARGETS FOR GENERAL PUBLIC**

| Frequency (MHz) | RMS value of electric field (V/m) | RMS value of magnetic field (A/m) | Power density of the equivalent plane wave ($W/m^2$) |
|---|---|---|---|
| 0.1 ÷ 300000 | 6 | 0.016 | 0.1 (3 ÷ 300000 MHz) |

The above targets are those that should be pursued in the evolution of the telecommunications infrastructure; for instance, when a new base station is rolled out, it shall not cause values in excess to the quality targets in any accessible location in its

vicinity. This evaluation must take into account also other sources already operating in the same area.

Finally, Table IV recapitulates the values defined by the Italian law for electric field, which is the one that is most frequently evaluated in both design and measurement of sources.

**Table IV. EXPOSURE LIMITS - RMS VALUE OF ELECTRIC FIELD**

| Frequency (MHz) | Exposure limit (V/m) | Attention threshold (V/m) | Quality target (V/m) |
|---|---|---|---|
| 0.1 ÷ 3 | 60 | 6 | 6 |
| > 3 ÷ 3000 | 20 | 6 | 6 |
| > 3000 ÷ 300000 | 40 | 6 | 6 |

## 2. Network architecture and operation

Possibly the main concern in designing the monitoring network was to ensure the independence of the measurements carried out, so that citizens might be confident that the presented results were not influenced by particular interests, such as those of telecommunications operators as well as political parties or other opinion groups.

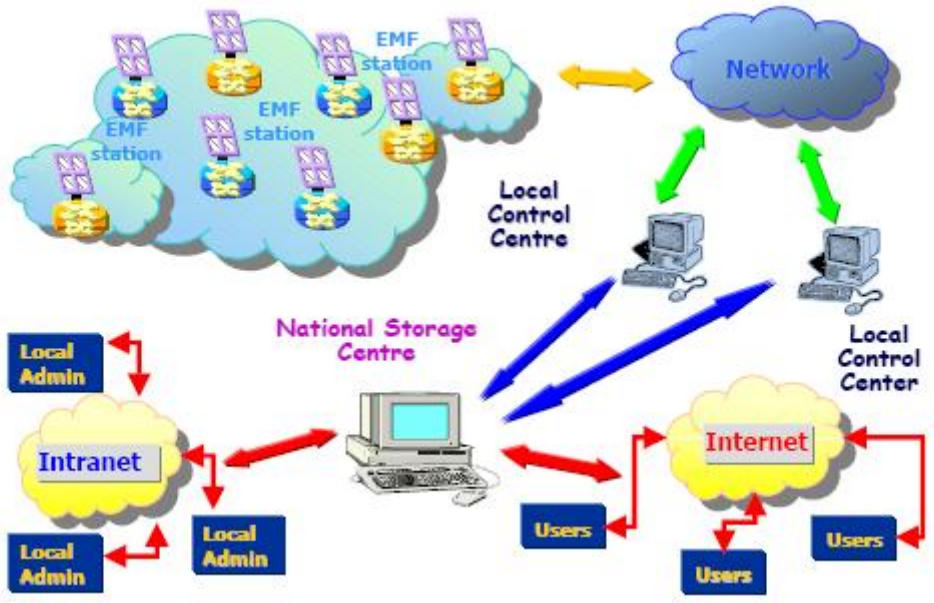


Figure 1. Architecture of the network for electromagnetic field monitoring

To this aim, since the onset, it was decided that the network would have been entirely funded by public money, without any form of sponsorship by operators or other non-institutional subjects. The Ministry of Communications charged FUB of the realisation and maintenance of the network, while its operation on the territory would have been under the exclusive responsibility of local administrations, through the respective Environmental Protection Agencies.

This led to a decentralised architecture of the monitoring system, represented in Figure 1. The network is based on remote measurement stations and on a transmission structure, devoted to the measured data flow towards Local Control Centres (deployed on a regional or sub-regional basis) and thence towards the National Storage Centre, which is located in the premises of the Ministry of Communications.

Remote monitoring stations were acquired through three subsequent public auctions, and the network in its full configuration comprises about 1200 of them. They were subdivided among Italian regions proportionally to their population, with a reference value of about one station per 50,000 inhabitants.

Both wide-band and multi-band probes were used to detect the electric field intensity due to all the radio-frequency sources working between 100 kHz and 3 GHz, in a range between 0.5 and 100 V/m. Wide-band probes can satisfy the basic requirement for the monitoring network, that is verifying the respect of the exposure limits over the whole frequency band. However, the availability of more advanced probes by most manufacturers allows a deeper insight into the impact of the electromagnetic field and its origin. In particular, two- or three-band probes yield a separate measurement of the electric field due to the main classes of sources, namely, broadcast radio/TV transmitters and mobile telephone base stations. Hence, the second and third auction have been focused on multi-band probes, since these can constitute an aid to the Environmental Protection Agencies in the process of interpretation and validation of the measured data.

The monitoring stations of all kinds are light, compact and easily transportable. This was explicitly required in the auction, because sensors have to be moved in order to monitor the Italian territory as thoroughly as possible.

It was suggested that a typical duration of a measurement campaign could be between two and four weeks; however this is not a strict rule, and actually each local Environmental Protection Agency decides in total autonomy which sites to monitor and for how long. This is essential to the successful usage of the monitoring network: as a matter of facts, certain locations (such as schools, hospitals, densely populated districts, sites with several co-located transmitters) are particularly delicate for various reasons, either political or technical, and it may be advisable to keep them monitored for longer periods than other areas.

In particular, this allowed the local authorities to perform an accurate monitoring also taking into account requests coming from groups or even individual citizens, concerned by the proximity of EMF sources to their home or workplace.

All remote stations operate with photovoltaic arrays and are equipped with a GSM modem, which is used for communication with the relevant Local Control Centre: the downlink is used for remote configuration, programming and polling, while the uplink is used for reporting the measurements and other information such as alerts.

The Local Control Centre consists of a PC equipped with ad-hoc software, which is capable of interacting with different types of monitoring stations. Once validated by the personnel of the local Environmental Protection Agency, the data are transmitted from each Local Control Centre by email to the FUB staffs, which upload them onto the database that constitutes the National Storage Centre.

The valid data are also publicly available on the web site www.monitoraggio.fub.it while the non-valid data are simply stored for documentation purposes, but are not considered in the official statistics.

**2.1 Dissemination of the results**

In order to promote a widespread dissemination of the results achieved by means of the monitoring network, data collected all over the national territory are available on a dedicated web site (http://www.monitoraggio.fub.it/) hosted by FUB.
The web site is structured in four different areas:

• *Informative area*: in this area general information on the network is given;

• *Communication area:* this area hosts two kinds of information. On the one hand details regarding the communication activity related to the network, such as the BluBus project, are given; on the other hand several notions on EMF are reported, both from the technical and health point of view;

• *Links:* this area links to several either scientific or institutional web sites relevant to the EMF issue. In particular the visitor can easily reach the web sites of the Regional Agencies for Environment Protection and contact them (e.g. requesting a monitoring campaign);

• *Data*: this area represents the core of the web site and contains all the data collected since the network kick-off. Results are presented in different manners in order to comply with the different requirements of the general public or expert users. Besides general synthetic information relative to the national or regional territory, raw data are available both as graphs or tables. Moreover, for each monitoring campaign, some synthetic results are presented, such as the mean EMF strength value or the percentage of samples below a certain threshold. It's worth noting that the collected data are freely available and could constitute a solid and reliable basis, unique in the world, at the scientific community disposal, in order to promote its diffusion and employment. The huge amount of data can give an extremely detailed snapshot of the exposition of different segments of population, as a function of geographical area, working places and more. The scientific community might employ the collected database for a long time, maybe longer than the monitoring activity itself, and this will easily allow promote research involving different topics, such as epidemiology, statistics and sociology.

**3. Results**

Space and readability considerations prevent us from giving here a wide account of the measured data, which amount to nearly 50 million samples (see Figure 2). Therefore, in this section we highlight here only the most significant aggregate data and the main considerations that arise from their analysis.

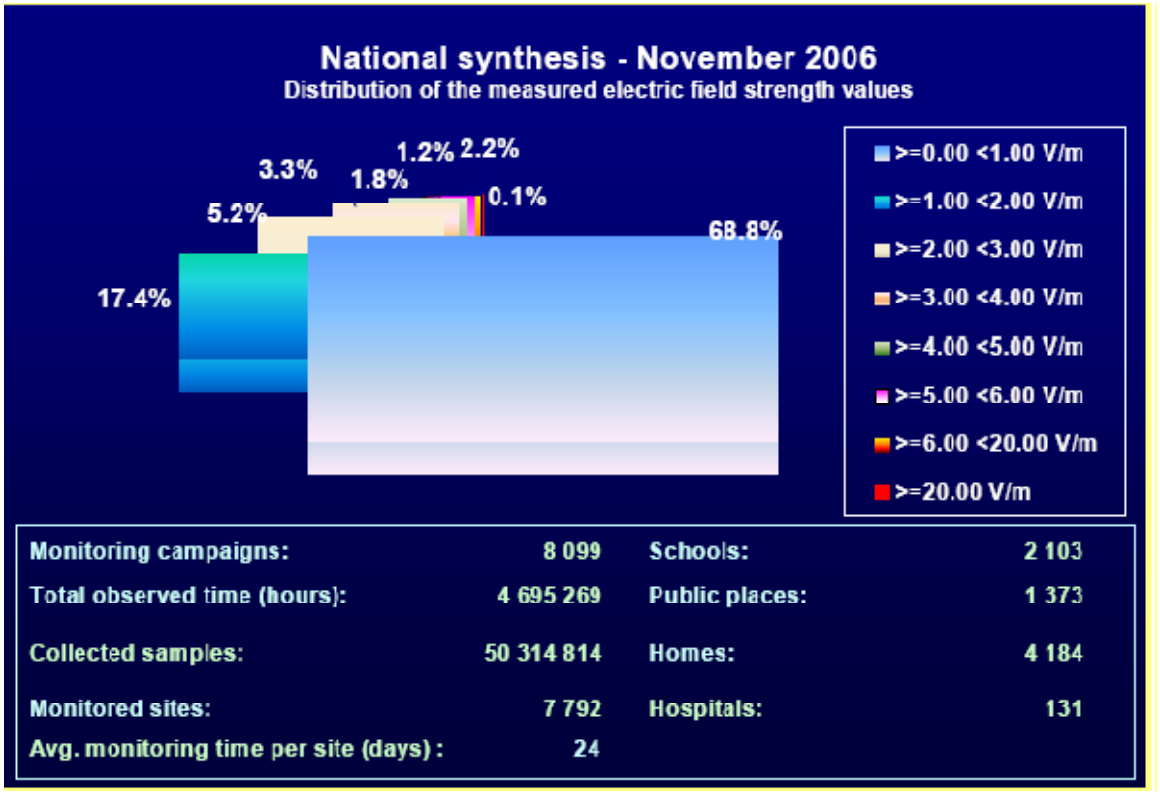


Figure 2. Summary of measurements results (as of November 2006)

The interested reader can visit the project's official web site (www.monitoraggio.fub.it, only in Italian) where all data are publicly available, with a resolution that allows any visitor to single out any particular data of interest.

Some considerations may be drawn from the results shown in the figure. The vast majority of samples are below 1 V/m, and over 90% is below 3 V/m. However, we have 2.2% of samples exceeding 6 V/m. The latter values exceed both the attention threshold and the quality target (see section I.1), but they do not necessarily imply that the limits have been violated, because in many cases they correspond to locations where there is not continuous presence of people.

In other cases, corresponding to actual limits violations, the monitoring results were useful in highlighting this problem and the necessary procedures for the reduction of the exposure were activated accordingly. Therefore, the monitoring network is an active instrument that local administrations can use to minimise exposure of the citizens to EMF.

From the above figure we also note that monitored sites have been divided in four categories: schools, homes, hospitals, and public places (which also include private premises opened to the public, e.g. shops). Results subdivided by site category are shown in the subsequent Figure 3. From these data we observe that the highest fraction of high field values were found in homes, while schools and hospitals are exposed to quite low field values, almost always below the limits.

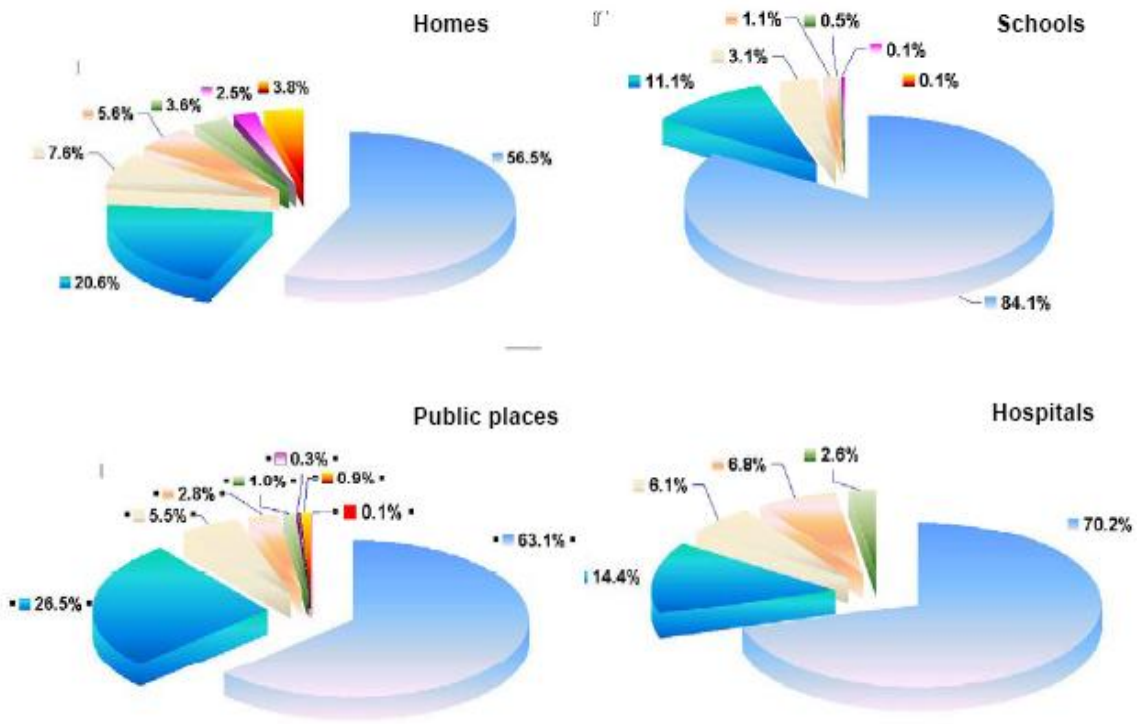


Figure 3. Summary of measurements results by location type (colour codes same as in Figure 2)

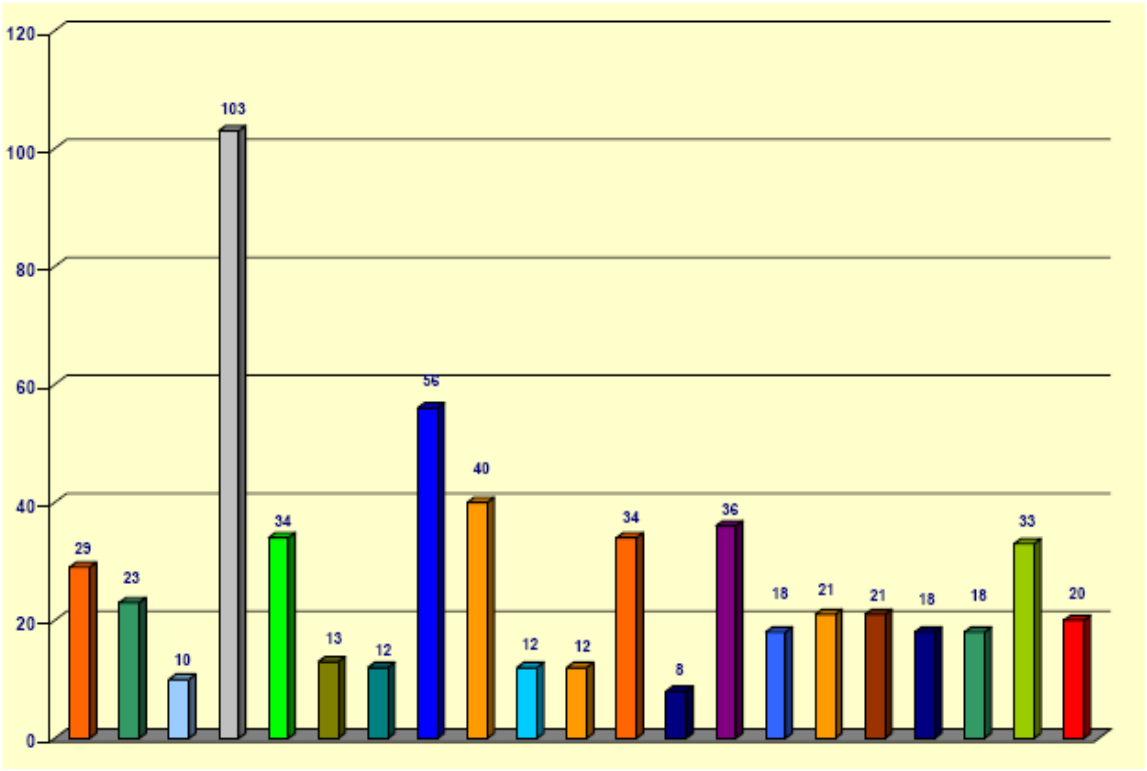


Figure 4. Average duration of measurement campaigns by Environmental Protection Agency (days)

Finally, Figure 4 and Figure 5 show respectively the average duration of measurement campaigns and the number of different measurement campaigns performed by each local Environmental Protection Agency. We observe a wide variety of different situations, with some Agencies performing a few very long campaigns while other preferred to perform several short campaigns.

These fluctuations were expected, because the local authorities are familiar with the needs and peculiarities of their territory; this confirmed that each local Agency acted in total autonomy and independence.

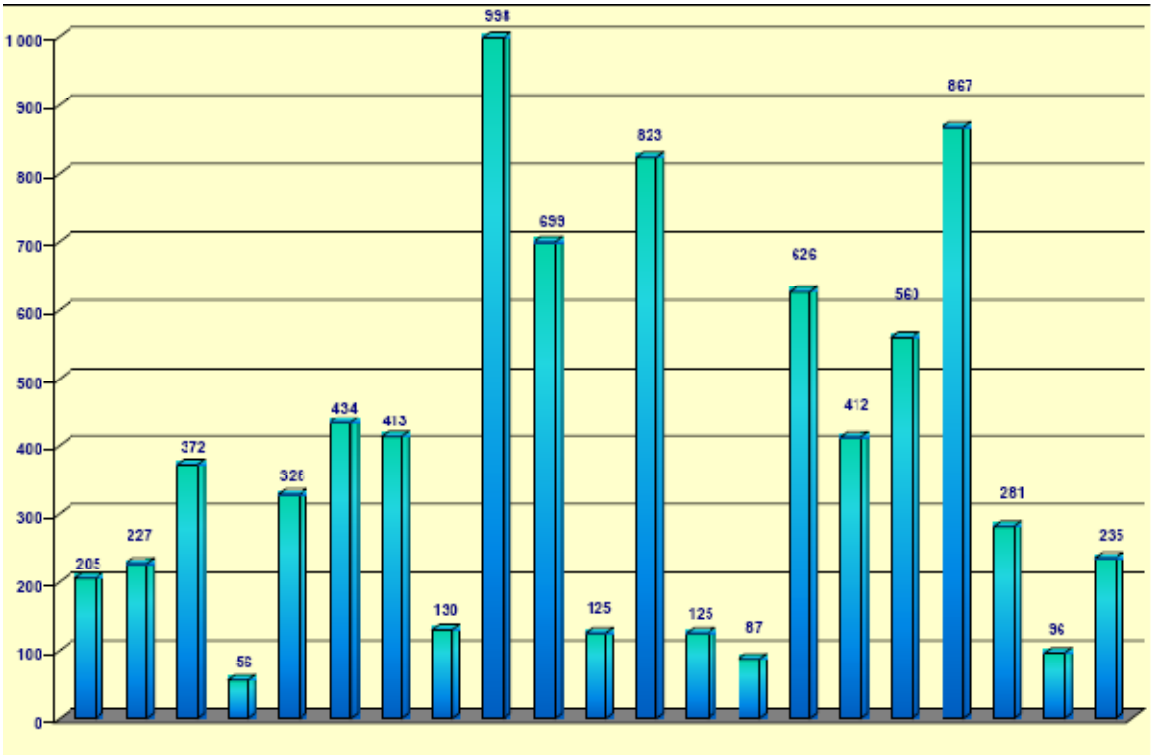


Figure 5. Number of measurement campaigns by Environmental Protection Agency

**4. The results communication campaign**

Even though the main focus of the paper is on the technical and engineering issues, a few words are purposefully spent on the communication campaign that accompanied the monitoring activity, in order to make Italian public aware of the efforts that were being done to evaluate the actual exposure levels and of the results that these efforts produced. Therefore, the Monitoring Network was complemented by an extensive public communication campaign, which was not limited to the publishing of measured data onto the web site, already mentioned in the previous section.

A quite innovative tool for communication of risks from EMF exposure is represented by the vehicles dubbed BluBus and Blushuttle; a project realised by FUB on behalf of the Italian Ministry of Communications, with the aim of delivering on-site correct, transparent, and complete information on the EMF exposure issue, directly to citizens.

The initiative started on 2003 from the idea of setting up a kind of itinerant conference as well as a mobile expertise laboratory, which can be provided to Local Authorities upon request.

The BluBus is a 12-metre bus, which represents at the same time a sort of mobile conference site and a portable EMF laboratory. Outside it is possible to place a tent capable of accommodating up to 50 people (see Figure 6).

Figure 6. The BluBus and the surrounding area

Figure 7. Stages of the BluBus

On board instrumentation includes various measurement equipment, in particular a PMM8053 portable EMF field meter, an EMF monitoring station with a remote control centre, and a spectrum analyser and a biconical antenna for narrowband measurements.

Every time the BluBus stops in a city square, a field monitoring station is placed just in front of it, so that a quick, real time demonstrative monitoring campaign is realised and data collected *in situ* can immediately be shown to the visitors. In addition to that, all visitors can receive information on FUB's activity and projects, as well as information and papers on EMF effects or on National Monitoring Campaign results.

The results obtained with the BluBus campaign have been really successful as shown in Table V. The table shows also the wide press coverage obtained by the BluBus communication campaign on media, which is a clear indication of its success as a way to inform population about the actual status and the scientific knowledge on EMF exposure. Figure 7 shows a graphical representation of the BluBus stages. During 2005 the BluBus campaign was extended by means of two city cars, called BluShuttles (see Figure 8), each equipped with a PMM8053 wide band EMF portable meter installed on its top and a computer containing an autonomous control centre.

| **Table V. BLUBUS IN SHORT (UPDATED DECEMBER 2006)** | |
|---|---|
| Travelled distance | Over 25,000 Km |
| Visited places | 130 |
| Stages carried out | 137 |
| Involved regions | 18 |
| Meetings attended | 20 |
| **Results in terms of communication to the citizens** | |
| Newspaper articles | 237 |
| Agencies | 129 |
| News on TV | 84 |
| Radio news | 16 |
| Articles on web | 101 |

The two BluShuttles can travel aside the BluBus during its stages, reaching the city centre where a 12-metre bus can hardly drive, or on their own, thus reaching small towns and villages more easily.

Figure 8. One of the BluShuttle equipped city cars during its visit in Venice

The BluShuttle can move easily from a place to another inside a city and in each point a short monitoring campaign that lasts about half an hour is performed. The car is stopped on the spot where the measure should be performed the system automatically makes a half an hour-long measurement then a synthetic sheet with the obtained results is produced, printed and distributed to visitors in real time. The report sheet produced by the control centre contains the general location data (address, present EMF sources,

coordinates), the photographic images of the place and of the sources, the average EMF level measured, and a chart with the levels of the EMF level during the half hour of measurements.

The two BluShuttles have performed a lot of stages on their own or together with the BluBus as shown in Table VI.

**Table VI. BLUSHUTTLE IN SHORT (UPDATED APRIL 2007)**

| | |
|---|---|
| Travelled distance | Over 12,000 Km |
| Visited places | 24 |
| Stages carried out | 29 |
| Involved regions | 9 |
| Meetings attended | 6 |
| **Results in terms of communication to the citizens** | |
| Newspaper articles | 18 |
| Agencies | 9 |
| News on TV | 3 |
| Articles on web | 3 |

During the period 2003-2006 the BluBus and the BluShuttles have been at Municipalities disposal and have travelled, upon Municipalities request, to several Italian cities. Now the activity of the BluBus vehicle is closed with a very favourable feedback from both the Institutions and the citizen. The activities of the two BluShuttle vehicles continue, because there are still a lot of requests from Municipality to carry out.

## 5. Conclusions

The paper illustrates the main issues that arose in designing, building and operating a nationwide EMF monitoring network along with a summary of most significant measurement results. The activity reached its goals, by showing that the vast majority of samples are well below the prescribed limits. In some cases the monitoring network allowed to detect excessive exposure values, and consequently the local authorities could activate procedures for the reduction of the field levels.

The monitoring network was complemented by a thorough communication activity that involved a website, press and media coverage, and direct meetings with the population carried out with innovatory means. As a result of this activity, the Italian population is now less concerned and more precisely informed about the actual electromagnetic field levels and their effect on human health.

**Acknowledgements**

A project as wide as the one shortly described in this paper obviously required the efforts of scores of people dealing with the multiplicity of aspects of such a complex task and it is not even possible to mention all their names here. The authors thankfully acknowledge the collaboration of all the personnel of the Ministry of Communications, of Fondazione Ugo Bordoni and of all the Regional and Provincial Agencies for Environmental Protection that made the Italian EMF monitoring network not only a reality, but a true history of success.

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# RF Exposure Measurement Campaigns - Between Pure Facts and Practical Risk Communication

Christian Bornkessel
IMST GmbH, C.-F.-Gauss-St. 2, D-47475 Kamp-Lintfort, Germany,

**Abstract**
RF exposure measurements, e.g. in form of measurement campaigns, are an effective instrument in the risk communication process. This paper summarizes the main technical outcome of such campaigns with a focus on mobile phone base stations, which is often contrary to the public view regarding to exposure magnitude and distribution. Also personal experience about measurement planning and performing in the measurement laboratory's view is presented.

## Introduction

RF exposure measurements, often performed in the framework of measurement campaigns, are an important instrument in the risk communication process. Therefore organizers, measurement personnel and presenters have a large responsibility for the public acceptance of modern communication technologies.

This paper focuses on mobile phone base station exposure. In an attempt to provide the public with independent information about typical exposure magnitude and distribution as a result of a measurement campaign it was realized, that the public perception on this subject is often contrary to the real world. The paper therefore starts with the "six most prominent mistakes in public perception of base station exposure" as a result of a long year's experience in performing and presenting measurement campaigns. After that, some personal experiences and impressions gained in the phases of planning and carrying out such campaigns are described, important for their acceptance and understanding.

## The six most prominent mistakes in public perception of base station exposure

During the measurements as well as while presenting the results we often made the experience, that the public perception of base station exposure is contrary to the real world. In the following the most common misinterpretations are summarized:

1. The base station exposure does NOT reach nor exceed the ICNIRP levels

It is often believed, that in places in the immediate vicinity of a base station ICNIRP exposure safety limits [1] are reached or exceeded. This is certainly not true! Measurements, which have been performed around hundreds or even thousands of GSM and UMTS base stations over the last months and years show, that typical exposures amount to only some percent of the limits concerning the electric field strength. It is worth to note here, that the statement "x percent of the exposure limit" without mentioning onto whether field strength or power density limits are used (both is possible) is useless and some times even confusing. Due to the quadratic relation between field strength and power density, e.g. 10 % of limit consumption for the electric field corresponds to 1 % limit consumption concerning the power density.

Safety limits are expected to be exceeded only directly in front of the base station antenna for distances, which are smaller than the regulatory safety distance, which is in the range of less than 10 meters for most sites. General public access is forbidden in these areas.

Figure 1 shows as an example the results of a measurement campaign, performed recently in the framework of the German Mobile Telecommunication Research Program [2].

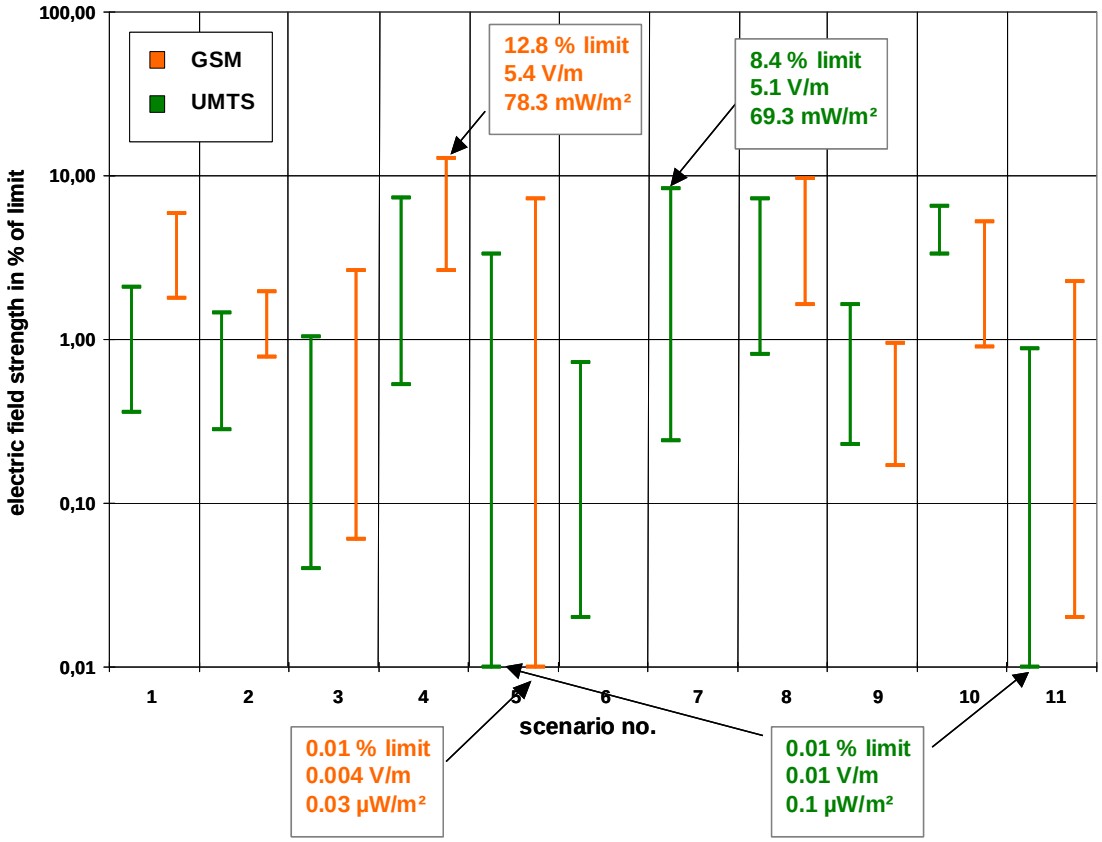


Fig. 1. Ranges of measured exposures at the 11 scenarios investigated in [2] (electric field strength in percent of the ICNIRP 98 reference level)

In the study "Determination of the real RF field distribution in the surrounding of UMTS base stations" measurements around the following 11 different basic scenarios were carried out with a special focus on sites with GSM and UMTS systems operating simultaneously, namely,

(1) Low mounted station, rural environment
(2) High mounted station, rural environment (mast)
(3) Base station in a commercial area
(4) Low mounted station, urban environment
(5) High mounted station, urban environment
(6) Ultra High Site (UHS)

(7) Station for indoor coverage
(8) Station for coverage of a football stadium
(9) Station for coverage of an exhibition hall
(10) Station for coverage of a pico cell
(11) Station on a roof, exposure in building below

The measurements showed time and space maximized exposures between 0.01 % and 13 % of the ICNIRP field strength limit. The mean values are 0.7 % for UMTS and 1.7 % for GSM. These exposures are in most cases also below precautionary limits introduced by some national authorities, as for instance in Switzerland.

2. Up to 100-200 m, the exposure is NOT declining regularly with distance

People often think, that the greater their distance from the base station, the lower their exposure. This distance-based principle is often used to establish "exclusion areas" around places like kindergartens or schools, in which base stations should not be built.

The analysis of the base station's exposure distribution in the vicinity of the station shows, however, that the exposure distance profile is a) quite irregular in the distance range from the station up to 100-200 m and b) the exposure is very often quite smaller inside this region than outside. Figure 2 shows as an example the exposure of all points with sight conditions to the base station obtained in a measurement campaign performed in 2004 in the city of Berlin [3]. Obviously, no clear exposure decrease with distance can be found, on the contrary the highest exposures were measured around 90 m.

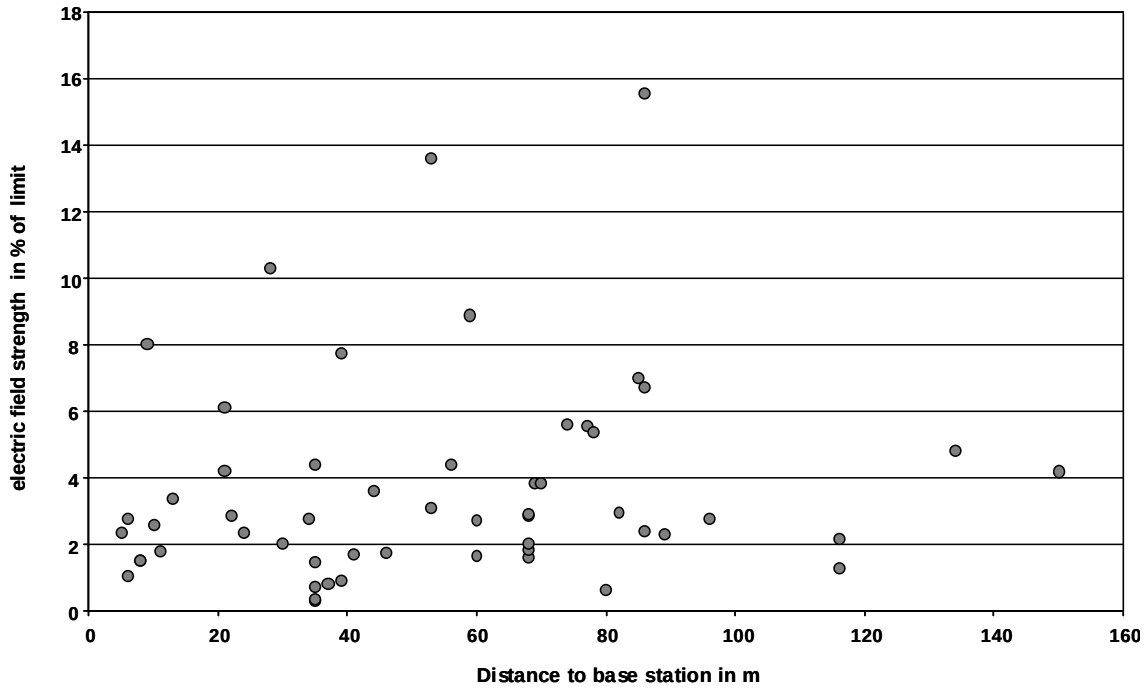


Fig. 2. Distance profile of measured exposures for points with sight to the station [3] (electric field strength in percent of the ICNIRP 98 reference level)

The reason for this distance dependence lies in the fact, that base station antennas do not radiate isotropically in all directions, but have a clear main radiation direction (main lobe). This main lobe is adjusted in that way, that it reaches the ground level at 100-200 m distance from the station (depending on the station's height), leading to an exposure maximum at this point and smaller exposure before and after this distance.

3. The number of visible base stations has NO influence on exposure

Another argument often heard in public discussion is the assumption that more (visible) base stations automatically lead to a higher exposure than a single base station. This is also not true, as investigated in [3] and shown in Figure 3: In the vicinity of a single base station (1 system means one base station with one standard, e.g. GSM 900), the same or even higher exposures were measured than in the surrounding of stations with more operators and/or standards. This means, that obviously other factors play a more important role in the exposure characterization.

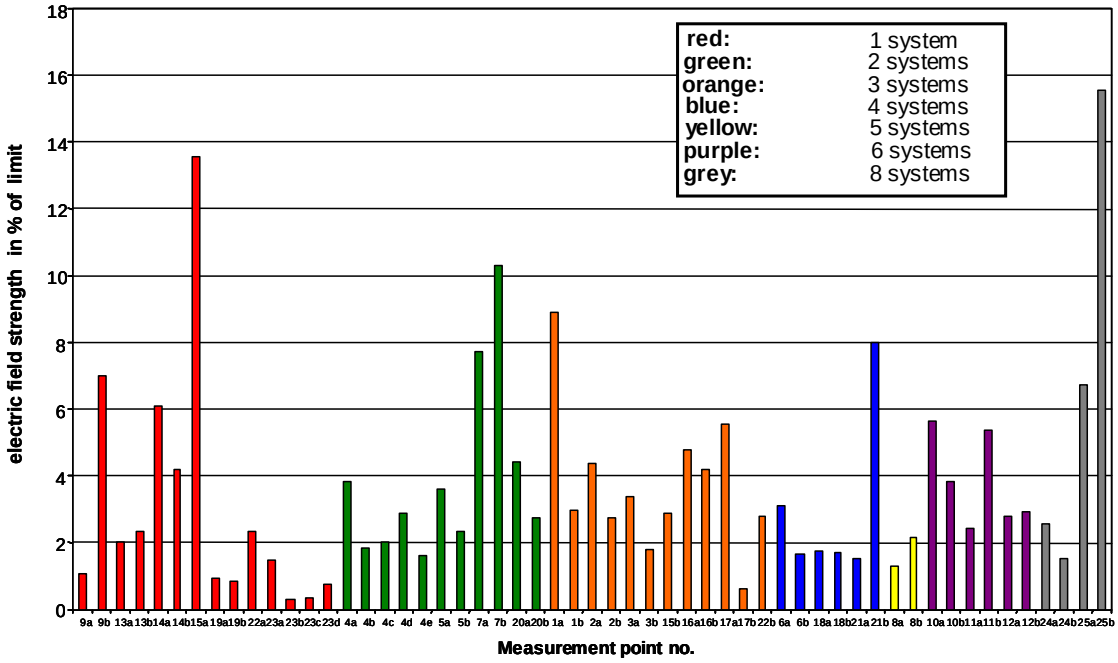


Fig. 3. Exposure as a function of the number of visible base stations [3]
(electric field strength in percent of the ICNIRP 98 reference level)

4. The ORIENTATION to the main lobe of the antenna is the dominating exposure factor

Instead of distance or number of visible base stations another factor was identified to be of main influence for exposure magnitude: The orientation to the main lobe of the antenna, which can also be expressed as the vertical angle, under which the base station antenna is seen from the measurement point.

Figure 4 shows as an example the dependence of the exposure on the vertical angle for the investigations performed in [2]: For vertical angles of -6 to 10°, which are in the range of typical downtilt angles of base stations, or with other words for measurement points

inside or near to the main lobe of the antenna, on average higher exposures can be measured than for points outside the main lobe. This effects is nearly independently on the distance, on the contrary the measurement points in the main lobe direction showing higher exposure are on average further away than the points outside the main lobe.

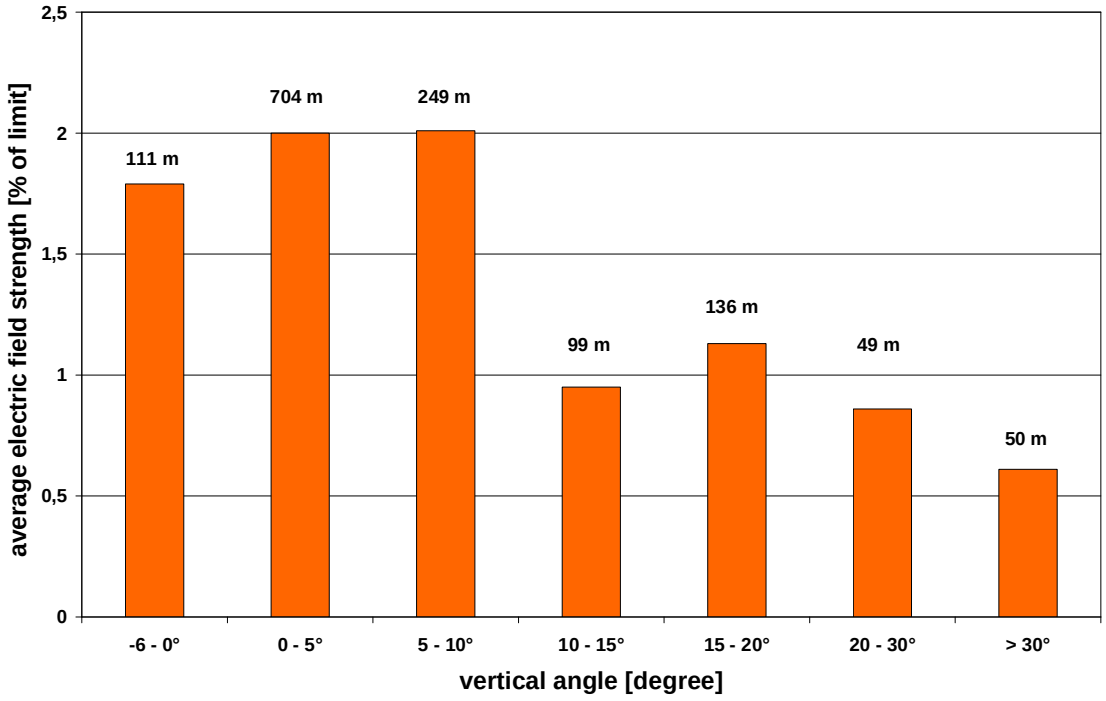


Fig. 4. Exposure as a function of the downtilt angle [2] (electric field strength in percent of the ICNIRP 98 reference level), numbers above the bars describe the average distance of the points to the base station

5. The installation of a new UMTS system does NOT mean a doubling of the exposure of an existing GSM system

Unlike the public opinion, the installation of a new UMTS system to an existing GSM system does not mean automatically a doubling of the resulting individual exposure. New investigations show, that the resulting exposure after the installation may be over or under additive to that of the existing system. Most interestingly, recent studies have shown, that at most measurement points in the surrounding of combined GSM/UMTS systems the GSM exposure dominates clearly.

Figure 5 shows the results of the GSM/UMTS measurement campaign [2] already mentioned in the examples before, showing a 85 % dominance of the GSM exposure of all relevant sites. The reasons for this behavior lie mainly in the broader main lobe of GSM 900 antennas in contrast to UMTS antennas; insofar the possibility for locations around the base station to be near or in the main lobe is higher for GSM 900 systems than for UMTS systems.

6. Base stations are NOT the main source of the individual exposure

A comparison of exposure data of different RF sources, as performed in [5] with special regard to the data obtained in studies of the German Mobile Telecommunication Research Program [4] is presented in Figure 6. In contrast to the public discussion, focused mainly on mobile phone base station exposure, the main source of individual exposure can clearly be identified to be devices, operated close to body or with body contact like mobile phones, DECT phones and WLAN notebook cards.

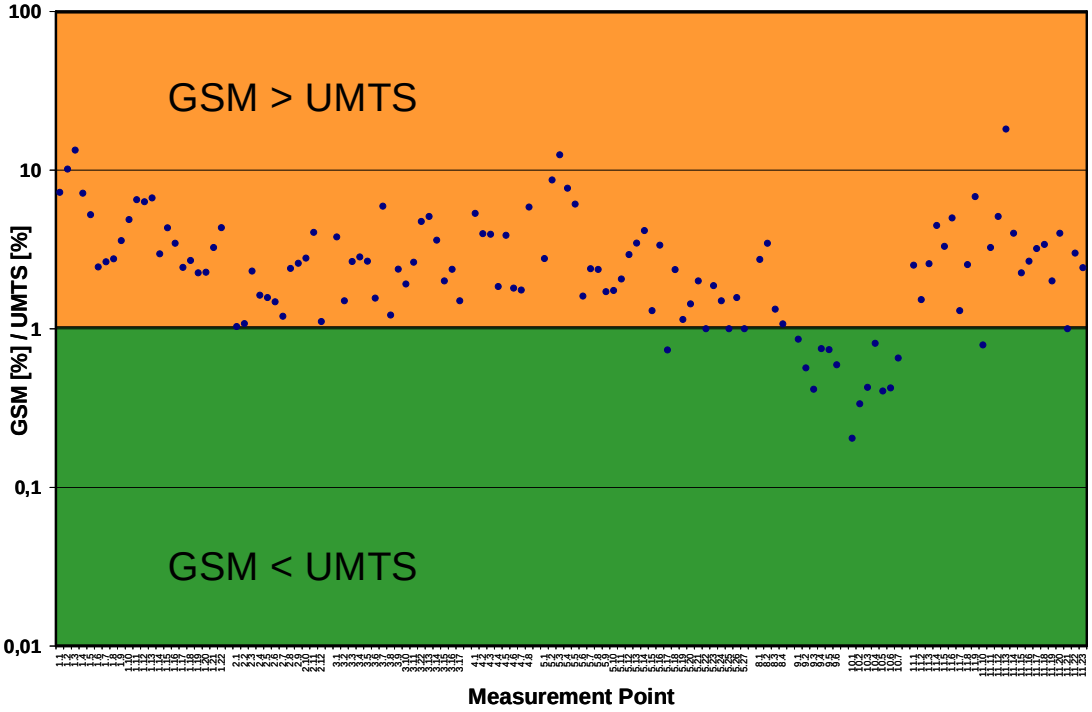


Fig. 5. Comparison of GSM and UMTS exposure of all measurement points of the campaign [2]

Mobile phone base station exposure measured under worst case conditions (i.e. focus on the locations with maximal exposure around the stations, spatial maximum search, extrapolation of the time dependent exposure to the maximal operational state of the station) is typically 20 dB higher than an “averaged” exposure (mixture of measurement locations distributed across the whole coverage cell, mostly inside buildings, time and space averaged exposure). This “averaged exposure” is in the same order of magnitude like typical radio and TV exposure or WLAN and DECT exposure. It is worth noting, that one exposure source is very often underestimated (because it is not measured mostly because of cumbersome measurement technique or even simply ignored): The exposure to long/medium/short wave (LMS) radio broadcasting transmitters. This exposure was found to be 10 dB higher (median value) than time and space averaged base station exposure. The LMS exposure is produced from only several 10 stations each country in contrast to several 10,000 base stations.

In conclusion, mobile phone base stations prove to be one important source of RF exposure and can be measured nearly anywhere. But their exposure has to be observed in the context of other RF sources, which may exhibit also relevant contributions to the

overall exposure, first of all sources, which are operated near to the body or with body contact.

**Practical recommendations from the measurements planning and processing phase**
In the following, some personal experiences and impressions gained in the phases of planning and processing of such campaigns are presented, important for their acceptance and understanding.

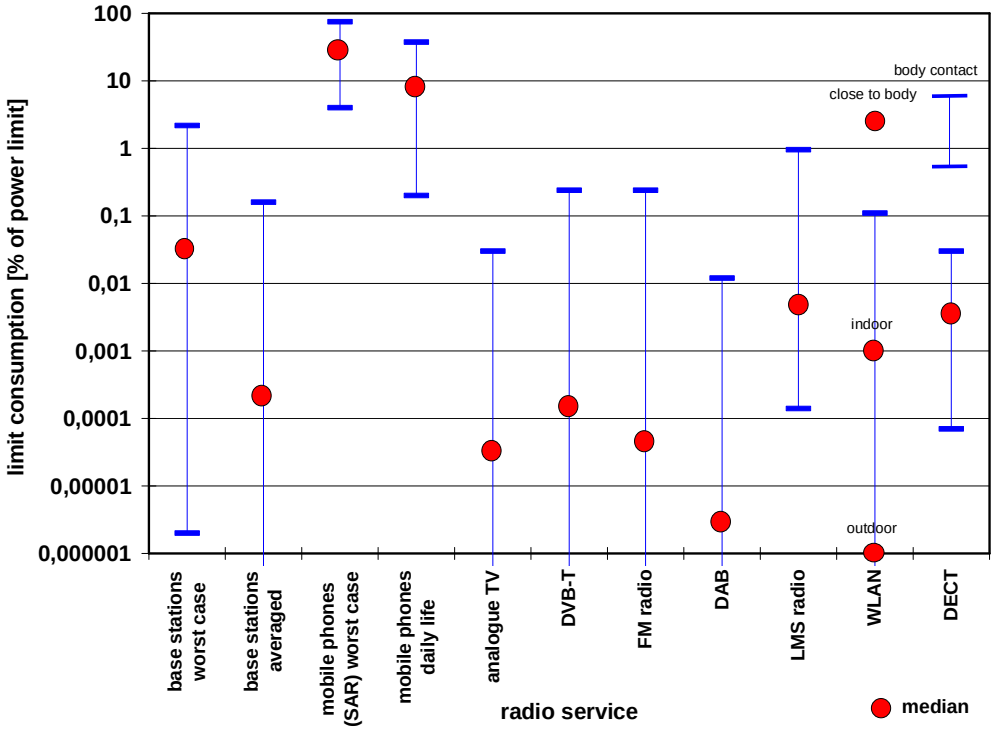


Fig. 6. Qualitative comparison of exposure contribution of different RF sources to general public exposure (compared to ICNIRP power based limits)

1. During planning

- The transferability of the results of earlier measurement campaigns is very limited with regard to other places. Citizens of Munich, for example, are normally not willing to accept measured exposure values in the city of Berlin to be representative for their own exposure, even if the scenario is the same. As a consequence, measurement campaigns often have to be performed for each Federal Country (or even each town) separately, although the propagation mechanisms of electromagnetic waves in Munich are the same as in Berlin.

- It may be useful to include local citizens' initiatives just in the planning, e.g. for proposing measurement sites and organizing the access. This has the positive side effect of reducing the effort for the measurement organization (which is often underestimated!). Also it is very important, that thus arguments like "the

measurement sites were chosen by industry to get lowest possible exposure" can be avoided, which would destruct the success of the whole campaign.

- In this context it is useful to invite representatives of local citizens' initiatives IN TIME to be present during the measurements. If representatives are not allowed to take part in the measurements, the results are suspicious.

- From our experience resistance against measurements is very seldom.

2. During the measurements

- The biggest mistake during measurements is to hide the results or to keep the measurement process secret from the other attendees. Everything must be open and visible for anyone! A good confidence-building measure is to take some extra time and to explain the measurement equipment and the results on the equipment screen. It gives a positive impression, if a simple broadband measurement device is handled over to an attendee of the citizens' initiative or to the resident (in case of measurements inside households) with the order to walk around and look for the place with the highest exposure.

- If appointments are made with local citizens' initiatives or the press at the measurement site, these appointments MUST BE KEPT, even if the measurements at the last site were finished earlier than expected.

- Due to the time required for communication purposes, 2 persons should carry out the (1 is measuring, 1 is communicating).

- It is also useful to give a first rough estimation about the existing exposure just during the measurements and not to argue, that the results must be first post processed before giving the final result (even if so).

- During measurements in households a very common argument is, that exposure limits are set more or less randomly and/or with cooperation of the industry. Insofar, the measurement personnel should be firm in some basic aspects of limit setting philosophy and present state of electro-biological research. The people are general very thankful for a clarification of these facts.

- Other arguments often heard in the field are a comparison with radioactive radiation (dose effect) as well as "the straw that breaks the camels' back".

- Most interestingly, sometimes we observed a large ignorance about the appearance of a base station. This is very astonishing, because this often happens in households, where people are very afraid of base station radiation.

- Sometimes it happened, that a visible base station caused fears and pain, although this base station was not in operation.

- Besides base stations, residents are often afraid of radio-controlled clocks, subterranean watercourses and electrical power lines.

3. In general

The results of measurements are generally accepted and trusted. One exemption is, if network operators or associated organisations have initiated and paid for the measurements and the measured exposure is clearly too small. Then it is nearly impossible to restore confidence.

Measurements are better received and have a higher degree of confidence than computational exposure predictions. Perhaps a combination of both would be ideal. Very often, measurements have helped to relax a confrontation between all parties.
This acceptance also means that in evening discussions the subject “measurements” is closed very quickly, whereas the discussion focuses then on biological effects of electromagnetic radiation.

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# The monIT Project
# Electromagnetic Fields Monitoring in Portugal

Carla Oliveira, Daniel Sebastião, Diana Ladeira, Luís M. Correia

Instituto de Telecomunicações / Instituto Superior Técnico, Technical University of Lisbon
Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal

**Abstract**

monIT is a Portuguese project on risk communication, providing public information on exposure to electromagnetic fields (EMF) from mobile communication systems. This objective is accomplished via different means, namely, a website www.lx.it.pt/monit, where all the data regarding EMF measurements near base station antennas is presented, as well as other relevant information. Other activities include collaboration with municipalities and risk communication actions held at shopping malls, where the project team is available to talk to the population and to clear doubts regarding EMF. In this paper, an overview of the main results from the monIT Project obtained until today is presented. EMF measurements results are summarised and a special attention is drawn on so-called sensitive locations, i.e., schools and hospitals. Results from measurements show that all analysed locations are in compliance with exposure thresholds. Also, all public actions performed by the project team and the media coverage of the project activities has increased the population awareness to the project and to its results, fulfilling its main objective: to inform the population.

## Introduction

monIT [1] is a Portuguese project on risk communication that began in 2003 in Instituto de Telecomunicações (www.it.pt), aiming at providing public information on exposure to EMF from mobile communication systems. The Project main information vehicle is its website (www.lx.it.pt/monit), where all activities are presented, namely, the results from the measurement campaigns performed across the country and relevant information regarding EMF, divided into basic and advanced levels.

monIT performs two types of measurement campaigns: continuous measurements, corresponding to data obtained through a network of autonomous remote probing stations during a 3 months period, and localised measurements, associated to data acquired in 6 minutes, being carried out in both indoor and outdoor environments. Up to now, about 500 locations were measured in all Portuguese regions. Other activities include risk communication actions held at public locations, where the project team is available to talk to the interested population and to clear doubts regarding EMF.

This paper is organised as follows. In Section 2, the results from the localised measurements are analysed with a special focus on so-called sensitive locations. Section 3 presents the main results from the continuous measurements, and Section 4 presents the main risk communication actions performed by the project team. Finally, some conclusions are drawn on Section 5.

**Localised Measurements**

Localised measurements are performed according to a measurement procedure [2], using certified equipment with an electric field (*E)* probe with a bandwidth of 100 kHz to 3 GHz [3]. This allows an evaluation of the total exposure level that one is subject to, resulting from the various communication systems in the location. In each location, the highest field value within the vicinity of the site is selected, according to its geometry. The equipment is then placed in each selected location, registering the *E* field for 6 minutes. The value is then averaged to allow the evaluation of the human exposure, and magnetic field (*H*) and power density (*S*) values are calculated. The *S* value is compared with the strictest reference level within the frequency band under analysis (2 W/m$^2$) [4].

In Figure 1 and Figure 2, the distribution of all measured points for outdoor and indoor scenarios is presented, respectively. One concludes that all measured points are in conformity with the reference levels. Also, the majority of the points (66 % for outdoor and 52 % for indoor) are at least 1 000 times below the reference level. Figure 3 shows the distribution of the points as a function of the distance to the base station antennas, for all outdoor measurements, and the upper bound threshold for all points. One may see that the distribution of the measured points is almost independent from the distance, since as the distance to the antenna increases, one may observe higher and lower field values. This may be explained by the fact that the equipment is wideband, and by the variable number of base stations and different topologies and scenarios. With this result, one may conclude that, in real environments, the distance to the antenna is almost irrelevant to evaluate the risk of exposure, in the sense that there is no simple expression that can be used to estimate the field magnitude; however, an upper bound can be estimated, which may be of use, but which requires care in doing so.

The so-called sensitive locations, such as schools, hospitals or nursing homes, are also a priority for the measurement campaigns. Taking the nature of the monIT Project into account, these locations are especially important, being now a focus of the Project. The Ministries of Health and Education, identifying eligible schools and hospitals performed an initial selection.

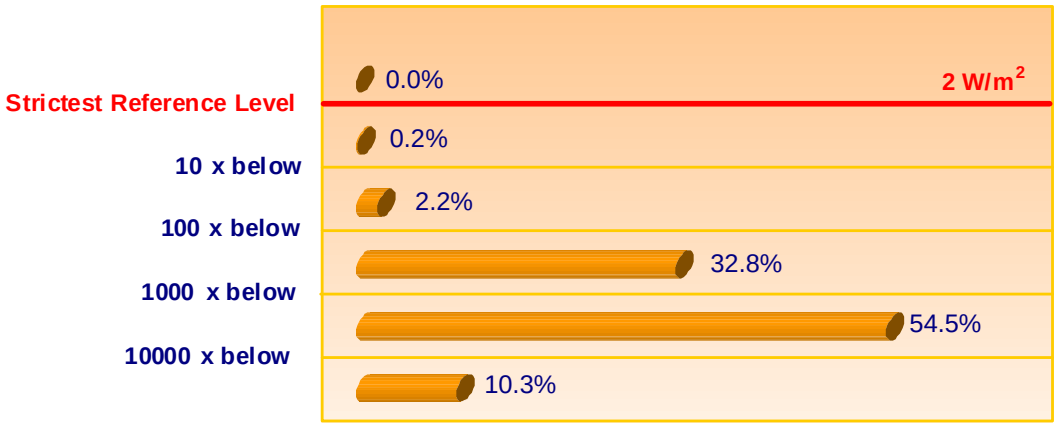


Figure 2. Distribution of *S* for outdoor measurements.

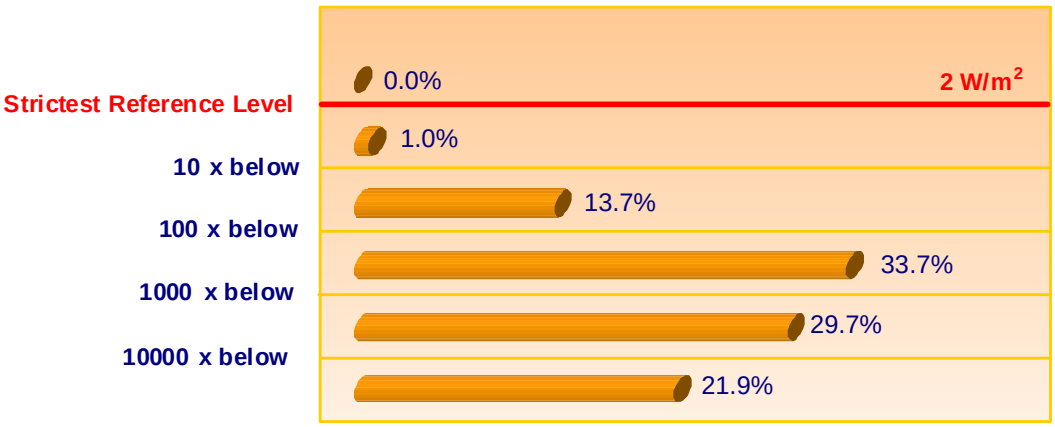


Figure 3. Distribution of *S* for indoor measurements.

Regarding schools, an inquiry was sent to the different schools spread across the country, in order to identify the ones with close proximity to base station antennas. Considering their characteristics, 124 schools were then selected. The Project team then established several criteria to select, which schools should or not be measured, based on various requirements, like the distance to the antennas, antennas visibility from the school campus, or type of communications system (mobile communications or other).

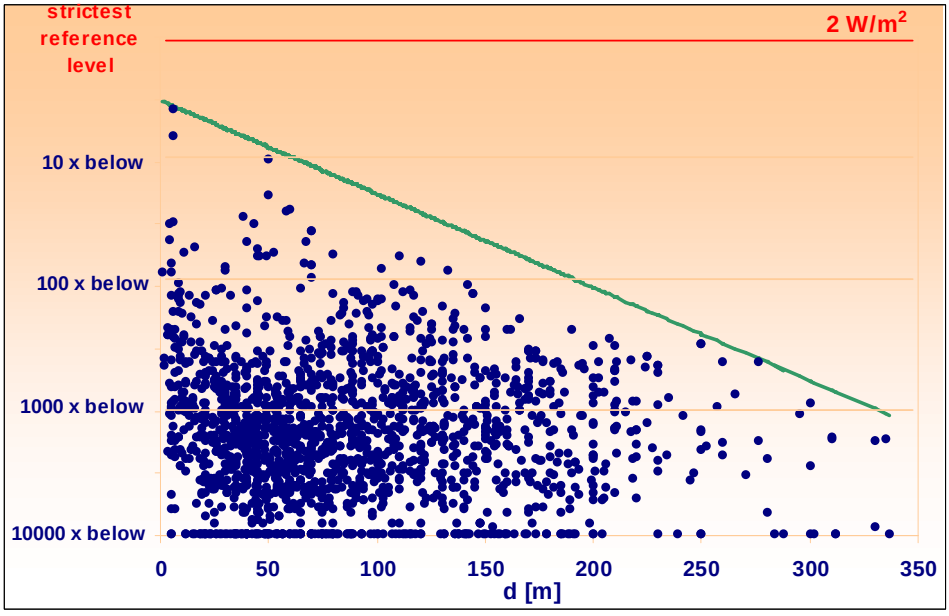


Figure 4 – *S* values in all the outdoor measured points.

From the initial group of schools, 48 were contacted until now, and 29 have already been measured. These measurements were performed in the outdoor areas of the school where higher field values are observed. In Figure 4, the results from all schools measurements are presented: there are no values registered above the reference level, and the maximum registered value is 27 times below the reference level (in terms of *S*); one should also note that this higher value was registered in a terrace only accessible to authorised personnel.

Regarding the hospitals selected by the Ministry of Health, they were asked to reply to an enquiry to identify its characteristics, e.g., cases of interference with medical equipment, restrains to the use of mobile communications equipment, and presence of antennas from mobile communication systems (both indoors and outdoors).

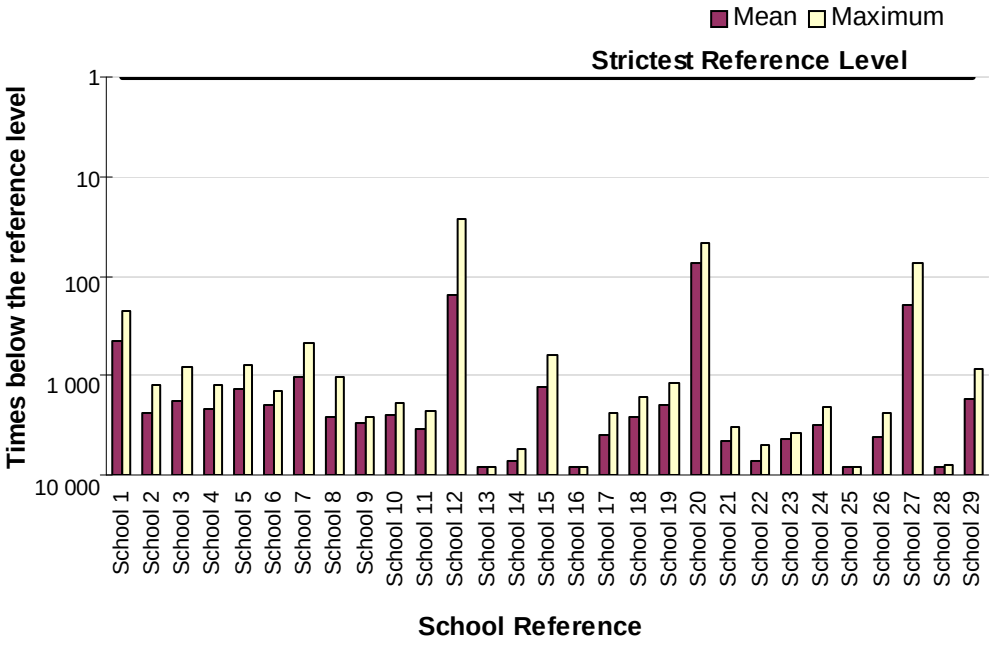


Figure 5. Results from the schools measurements.

As hospitals are special indoor locations, the **monIT** measurement procedure had to be adjusted to their specific conditions. This new procedure [5] includes the requirements of compliance with both the reference level in terms of human exposure to electromagnetic radiation, [1], and with the EMCT (Electromagnetic Compatibility Threshold). The EMCT analysis is based on the International Electrotechnical Commission standard [6], which specifies levels of immunity that different devices should guarantee, as well as a set of tests to guarantee these levels. The perspective of this procedure is to analyse the EMF levels present in several location units, independently of the system or mobile equipment, and to compare them with the minimum immunity level (23.87 $mW/m^2$, or equivalent 3 V/m, in the band of 800 MHz to 2.5 GHz). In each hospital, the privileged measurement points are those close to indoor communication systems antennas, or in high sensitive locations, e.g., Intensive Care Unit (ICU), Operation Room (OR) or Emergencies Room (ER), and with line of site to outdoor antennas of mobile communications.

Until now, 11 hospitals have replied to the enquiry and 8 have been measured. The results of all measured hospitals are presented in Figure 5, being compared with both the strictest reference level and the EMCT. The figure allows one to conclude that all measured points are in conformity with the human exposure reference level, and also that the highest value registered is 18 times below the reference level. In 2 hospitals, some measured points are above the EMCT, but these values were registered in administration areas, without medical equipment in the vicinity, hence, they have no influence in the EMCT study. In the areas with medical and life support equipment, all the measured points are in compliance with the EMCT.

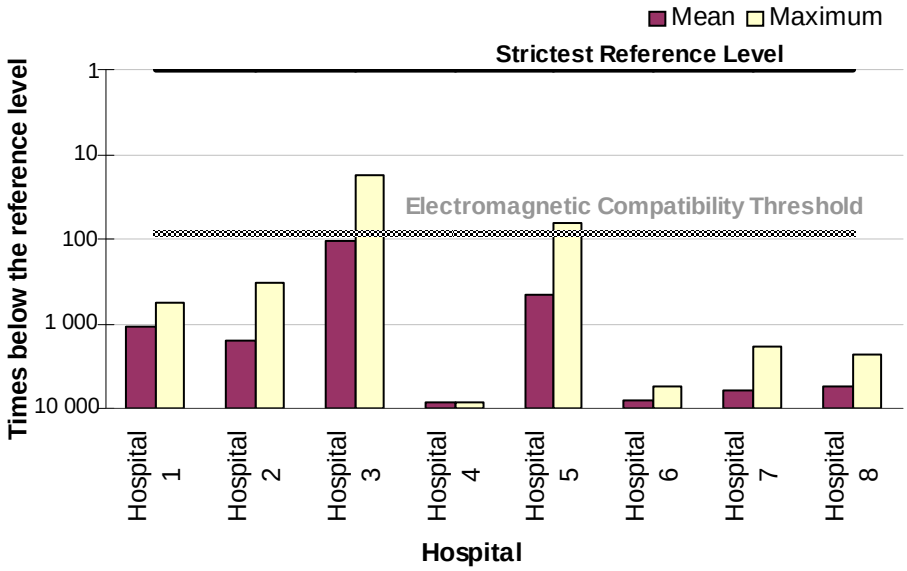


Figure 6. Results from the hospitals measurements.

**Continuous Measurements**

Continuous monitoring is another type of measurements performed by the **monIT** Project. This kind of measurements is performed autonomously, with remote probing stations located at several locations, forming a network. The continuous measurements allow one to study EMF variations along time at the installation locations, and to evaluate compliance with reference thresholds. These measurements are performed in cooperation with local municipalities, which are responsible for the selection of the locations where probing stations are installed. These locations are selected by their proximity to base station antennas and to public areas, good solar exposure, and good security conditions. Places near so-called sensitive locations (as schools or hospitals) are preferred.

These probing stations [7] work in a fully autonomous way, sending data to the **monIT** server by using a GSM link. Data is then processed and presented automatically in the website. The probing stations have a bandwidth of 500 kHz to 3 GHz, and the strictest reference level within the frequency band under analysis is 2 $W/m^2$, as in the localised measurements results.

Until now, 107 locations were measured for a period of at least 3 months each, in 19 municipalities. Figure 6 illustrates an example of how continuous monitoring results are presented in the website. The website visitor can choose to see results, for both *E* and *S*, from the previous day, week, and month or from all the monitoring period.

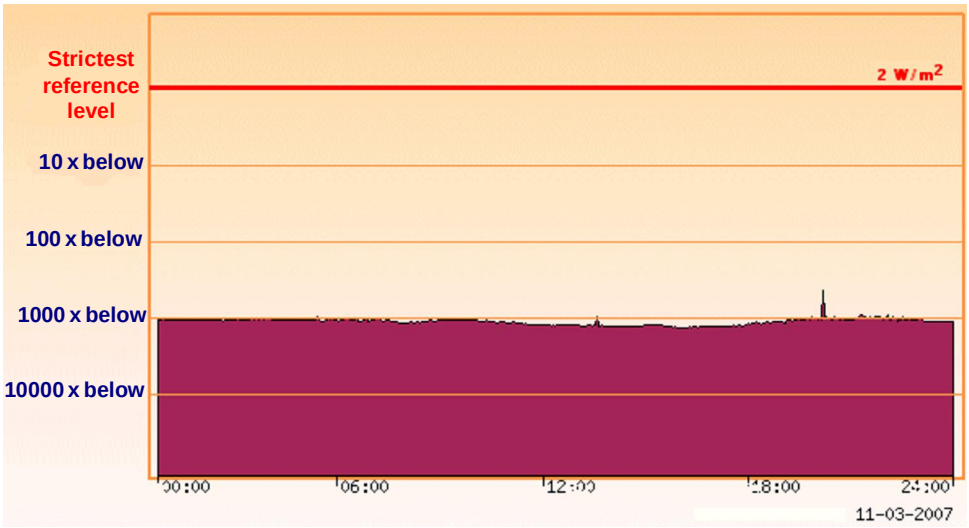


Figure 7. Continuous monitoring results.

At the end of the monitoring period, a report is produced with the main results from the measurements, being distributed to local authorities (including health ones). In Figure 7, the main results from all monitoring networks active in 2006 are presented, by the average and maximum field values registered. As one may see, no values were registered above the exposure reference level, and the highest value is more than 10 times below this level.

**Risk Communication**

The main focus of the **monIT** Project is to inform the population on exposure to EMF, namely from mobile communication systems. The main vehicle of information is the Project website (www.lx.it.pt/monit), Figure 8, where all the information is presented to the population.

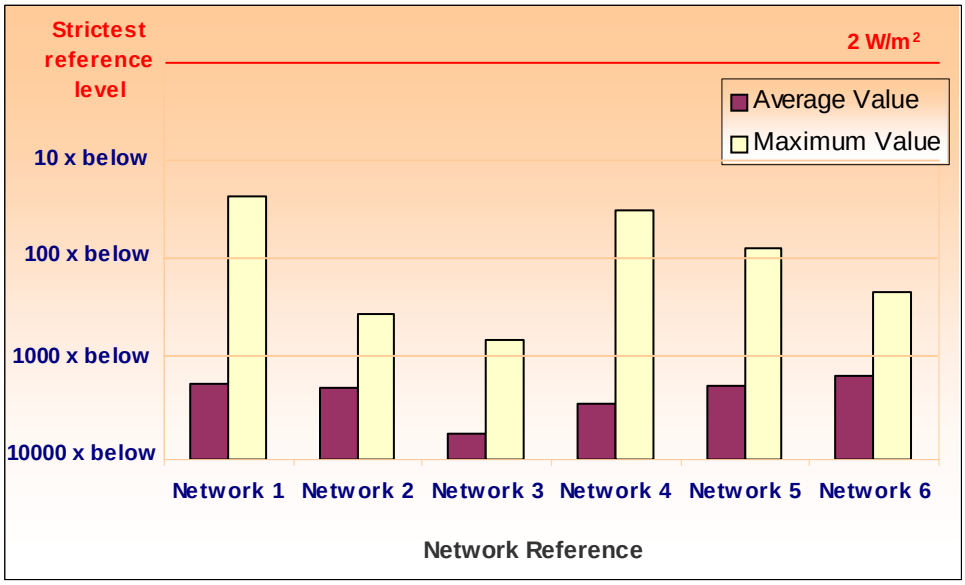


Figure 8. Average and maximum values registered in all active networks in 2006.

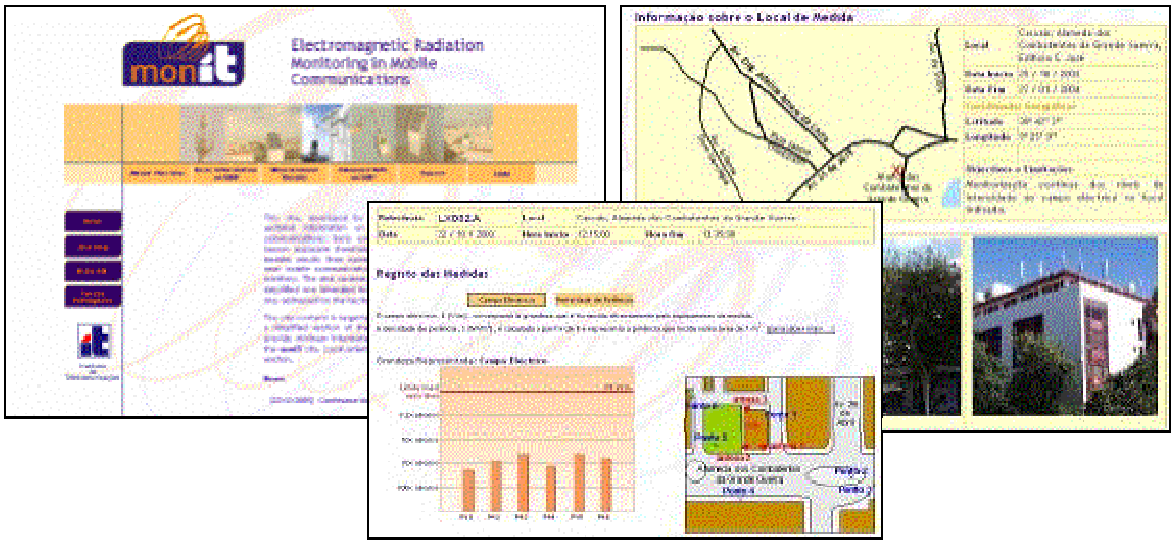


Figure 9. monIT Project website screenshots (www.lx.it.pt/monit).

The website presents information regarding exposure to EMF in two different ways: basic and advanced levels. The basic level is intended to people without technical knowledge on mobile communications, EMFs or related issues; for such, just the basic notions are explained in a simple and easy understandable way, and a glossary of concepts is also available. The advanced level is the opposite of this, as it is intended for people with some technical background. It includes references to more detailed information, to the standards and laws regarding reference levels, and other relevant documents and studies produced both by the **monIT** team and by international reference institutions.


Figure 10. Risk communication action.

Besides the information pages, the website also includes a links section, with links to websites of national and international entities working in the area of radiation exposure. Another main area of the website is the measurement results page, which includes reports from all localised and continuous measurements performed. Reports present the measured values and their compliance with the reference levels, including also schematic and photographic information about the location of the measurement.

Website visitors' preferences show the success of the project main role of informing the population. These statistics show that people accessing the website are fundamentally looking for information regarding radiation exposure, or to check the results from the measurements performed by the project team. The project team is also involved in risk communication actions performed at public locations, Figure 9. These actions are held primarily at shopping malls, where it is possible to contact directly with the population. In these actions, the project team is available to talk to the population and to clear doubts regarding EMF. These actions have had some media coverage, especially in the Portuguese public TV, which have helped to increase the overall visibility of the Project and also of the public actions. This is fundamental for the fulfilling of the project main objective: to inform the population.

**Conclusions**

monIT emerged in 2003 as a risk communication initiative, intending to contribute to the spread of knowledge concerning exposure to EMF at the national level in Portugal. The main vehicle of information is the website (www.lx.it.pt/monit), where information regarding exposure to EMF is available, with two levels: a basic one, for people without any knowledge on the subject, and an advanced one, for the interested specialised community.

The website contains reports with the results from all the measurement campaigns. Two types of measurements are performed: localised and continuous monitoring. More than 500 locations have been measured so far in all the districts spread across the country. The measurement campaigns started in public locations near base station antennas of mobile

communications, and now the focus is on so-called sensitive locations, like schools or hospitals, in cooperation with the Ministries of Education and Health.

Results from measurements show that all measured points are below the reference levels. Moreover, more than 66 % of the outdoor measured points and 52 % of indoor ones are at least 1 000 times below the reference level. In hospitals, an analysis of the electromagnetic compatibility compliance is also performed, with the results showing that in the areas with medical and life support equipment, all the measured points are in compliance with the respective threshold.

The project team is actively involved in risk communication actions held at public places, primarily at shopping malls, being available to talk to the population and to clear any doubts regarding EMF exposure. These actions have had visible media coverage, mainly by the TV, helping to inform the population, and achieving the main goal of the project.

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# Measurement and Information Series 'Confidence by evidence - TÜV and IZMF Examine Mobile Telecommunications'

Dagmar Wiebusch (Managing Director and Project Leader IZMF)
Dr. Fritz Lauer (Chairman IZMF)

TÜV: Technischer Überwachungsverein (Technical Inspection Authority, Germany)
IZMF: Informationszentrum Mobilfunk e.V. (Information Centre for Mobile Communication, Berlin)

**Abstract**

About one third of the German population is afraid of health problems caused by mobile telephony electromagnetic fields (EMF). This fear is often based on preconceptions and a significant lack of knowledge about physical and biological facts[1].

It is the overall goal of the described 'Measurement and Information Series' to make the dialogue about mobile communications fact-based and to raise the level of awareness of the target audience regarding mobile telecommunication technology. The measurement concept aims to investigate typical exposure scenarios and to extrapolate measurement results for comparable locations.

The measurements are conducted and evaluated by independent experts (TÜV Nord, IMST GmbH). The measuring points are chosen by the participating municipalities and are located exclusively in the vicinity of transmitting stations (< 300 meters). Measurements at external sites are performed according to the Guidelines of the Federal Network Agency for nationwide EMF measurements. In addition, a procedure using the radial method is used. The readings of the focussed mobile telecommunications specific measurements are then extrapolated to determine the maximum possible load for transmitting stations. Information about the measurement activities and results is announced in press conferences, professional workshops, exhibits and road shows, where experts are present for discussion. All results and evaluations are documented in a brochure as well as via Internet.

Up to now the 'Measurement and Information Series' has been performed in five federal countries: North Rhine-Westphalia (NRW; 2003), Hesse (2004), Lower Saxony (2005) Thuringia (2006) and Saxony (2007). It proves to be an efficient instrument of explaining the functioning and the risks of mobile telecommunications. The cooperation partners of the 'Measurement and Information Series' approve that more confidence and less health concerns about mobile telephony are evident in all federal states where the campaign has been performed.

[1] Results of the representative INFAS (Institute for Applied Social Sciences) surveys (Perception of Mobile Telecommunication), initiated by the Bundesamt für Strahlenschutz (BfS, Federal Agency for Radiation Protection) as part of the German Mobile Telecommunication Research Program

**Background**

Since the early 1990's, the skepticism of the general public regarding mobile telecommunication technology has increased in proportion to the comprehensive expansion of cellular networks in Germany. Even though it is an intensively researched area of environmental medicine, the majority of the general public is insufficiently informed about high-frequency EMF distributions and effects. The results of representative studies, initiated by the Bundesamt für Strahlenschutz (BfS, Federal Agency for Radiation Protection) as part of the German Mobile Telecommunication Research Program (2003 – 2006) have shown: approximately one third of the Germans is afraid that mobile telecommunication fields might have a negative impact on their health. This fear is based on many preconceived notions and a significant lack of knowledge about physical and biological facts. Only about half of those questioned were aware of the legally established safety margins. Even fewer were aware that the field intensities, at which mobile telecommunication stations operate, are far below these safety margins. This lack of information makes an objective dialogue very difficult and feeds the fear of apparent health risks. In order to enable citizens to assess mobile telecommunication technology properly, the available information has to be presented to them in a factual and clear manner.

IZMF, the Information Centre for Mobile Communication, was established 2001 in Berlin in order to inform the public and the media about mobile telecommunications and health. It is a non-profit organization, supported by mobile telecommunication operators. IZMF is the organizer and sponsor of the development and implementation of a 'Measurement and Information Series' campaign as described below. Since 2003, this campaign has been carried out in five German federal states during a six-month period each: North Rhine-Westphalia (NRW; 2003), Hesse (2004), Lower Saxony (2005) Thuringia (2006) and Saxony (2007). The leading slogan is: 'Confidence by Evidence – TÜV und IZMF Examine Mobile Telecommunications'.

**Objective**

The overall objective of the campaign is to facilitate a fact-based dialogue about mobile telecommunications in the media and the public. This requires raising peoples' level of awareness about mobile telecommunications. The public at large, the media, local authorities and those who serve as information providers (such as municipal representatives and physicians) shall receive clear and transparent information regarding EMF emissions. Furthermore, the understanding of scientific evaluation methods and the determination of safety margins shall be improved.

In order to guarantee integrity and social benefit, most of the campaigns were carried out in cooperation with the respective federal state's ministry of the environment. To ensure objectivity, the respective states' agencies responsible for immission protection have technical control over the measurements. The municipal central organizations chose a selection of municipalities who will then on their part propose the locations of the measurements.

The measurement concept aims to investigate typical exposure scenarios in order to extrapolate results for comparable locations. Since the BNetzA (Federal Network Agency) is observing in the context of the site certification procedure for stationary telecommunication stations that the legal safety margins according to 26 BImSchV

(Federal Immission Protection Guideline) are maintained, this has never been a priority objective of the campaign.

**Methods**

a) Measurement service providers

The IZMF has selected two service providers for the planning and implementation of the measurements that are independent and experienced with mobile telecommunication measurement technology: IMST GmbH, a development company for mobile telecommunications and micro electronics, and EMV Services GmbH, a subsidiary of TÜV Nord Gruppe. While IMST GmbH is responsible for the development of the measuring concept and the evaluation of the results, EMV Services GmbH's engineers carry out the measurements. Both companies are accredited by DAR (German Accreditation Agency), KBA (Federal Bureau of Motor Vehicles and Drivers) and by the EBA (Federal Railway Authority).

b) Measurement concept

The measuring concept developed by IMST GmbH aims to investigate areas that are of special interest to the public: the direct surroundings of base stations (50 – 300 meter circumference) and interiors such as children's rooms, bedrooms, schools and hospitals. It is focusing on typical exposure scenarios in order to extrapolate measurement results for comparable locations. The readouts provide information regarding:

- The spread of EMF in the immediate vicinity
- The intensity of EMF of GSM- and UMTS-antennas
- The influence of building insulation on emissions
- Comparison with other EMF sources (radio, TV, DECT telephones)
- Emission variations over 24 hours (long-term measurements)

c) Measurement procedures

The TÜV engineers determine the performance flow densities occurring in the immediate vicinity of mobile telecommunication base stations for D and E networks as well as UMTS networks at all measurement points. The DVB-T transmitting stations are another point of interest since the new transmission technology for digital television has gone into operation. In case other sources, such as radio and television or cordless telephones, contribute significantly to the total emission level, they are also measured and considered in the final evaluation.

In order to guarantee maximum transparency and a reliable comparison of the results, all measurements at outdoor locations are carried out according to the "Guidelines for countrywide EMVU measurements of the surrounding field strength per regulation TP MV09/EMF/3 of the Federal Network Agency". This regulation was developed in coordination with the environment ministries of the respective states. It sets the generally accepted standard for EMF measurements. The measurement regulation meets the European as well as the national requirements for evaluation of protection of individuals from EMF. On request of the Ministry for the Environment of Lower Saxony and of Thuringia all results obtained according to this regulation were accepted by the Federal Network Agency and adopted in their EMF database.

In order to filter out the emission caused by mobile telecommunication from the acquired results of high frequency emissions, an additional measuring process is used that selects frequencies by a radial method. For this procedure the experts guide a measuring antenna through a room between 0.75 and 1.75 meters above the floor. The antenna registers the greatest field strength respectively for each frequency. This radial method is particularly important indoors, as the EMF can differ greatly due to reflections, shadowing or superposition. In this case, the radial movement of the antenna ensures that the engineers do not erroneously take their measurements in a local minimum of field strength. The results of the measurements are then extrapolated to determine the capacity utilization of a base station. The measurements of UMTS areas are also supplemented by extrapolation of the detailed testing using the radial method.

d) Communication

Various channels of communication are utilized to inform as many citizens and information sources as possible about the study and its results. Therefore the IZMF has commissioned a number of independent experts in the areas of measurement technology, medicine and risk communication to evaluate the measurements that have been collected. This makes it possible for citizens to inform themselves what kind of emissions typically occurs in their neighborhood and how these should be evaluated from a medical point of view. Representatives of this group of experts are available as consultants at press conferences, information events and specialized workshops. Their contribution to the dialogue is also published in the brochure accompanying each campaign.

The public relation measurements in detail:

*Media relations*

- Press conferences are held at the beginning (kick-off) and at the end (results)
- Journalists of regional newspapers, TV and radio stations witness all measurements
- Cooperation with the media (enclosing the informational booklet “Mobile Telecommunication Guidebook” as attachment to a regional daily)

*Events*

- 1 week travelling exhibition “Simply Mobile” in a highly frequented shopping area
- Participation in state-specific exhibits (e.g. Lower Saxony Day)
- Specialized workshops for municipal representatives and representatives of local administrations
- Certified advanced training courses for physicians, psychologists, public health services staff and medical organizations
- 1 week road show in the respective state

*Publications*

- The measurement campaign is accompanied by various printed and online publications, such as Comprehensive brochure entitled ‘Confidence by evidence – TÜV and IZMF Examine Mobile Telecommunications’, which is available in a printed version and online.
- Presentation of the project/results on the websites of IZMF and its cooperation partners

- Publication of the TÜV measurement reports 'Confidence by Evidence – TÜV and IZMF Examine Mobile Telecommunications' in a printed version and online on the IZMF homepage
- Publication of the measurement results in the EMF database of the Federal Network Agency on request of the state governments

**Results**

a) Measurement results

The approximately 400 readings of mobile telecommunication EMF strength taken by TÜV Nord (EMV Services GmbH) in the immediate vicinity of GSM and UMTS mobile telecommunication stations are significantly below the safety margin. Only a very small fraction of the legally permitted limit is utilized. Even the highest value, determined through extrapolation based on a theoretical maximum, utilizes only 1.5 percent of the permitted safety margin of EMF strength. Measurements over a time period of 24 hours confirm that the theoretically possible maximum utilization practically never occurs. Even at peak time, when many participants are logged in at the surrounding base stations, on average only a few thousandths of the permitted safety margin are utilized. At night, after 10:00 p.m., the emission sinks to an absolute minimum and begins to rise again slowly around 8:00 a.m., when more calls are being placed (see for instance Figure 1, showing the results of a 24-hour long-term measurement in Thuringia).

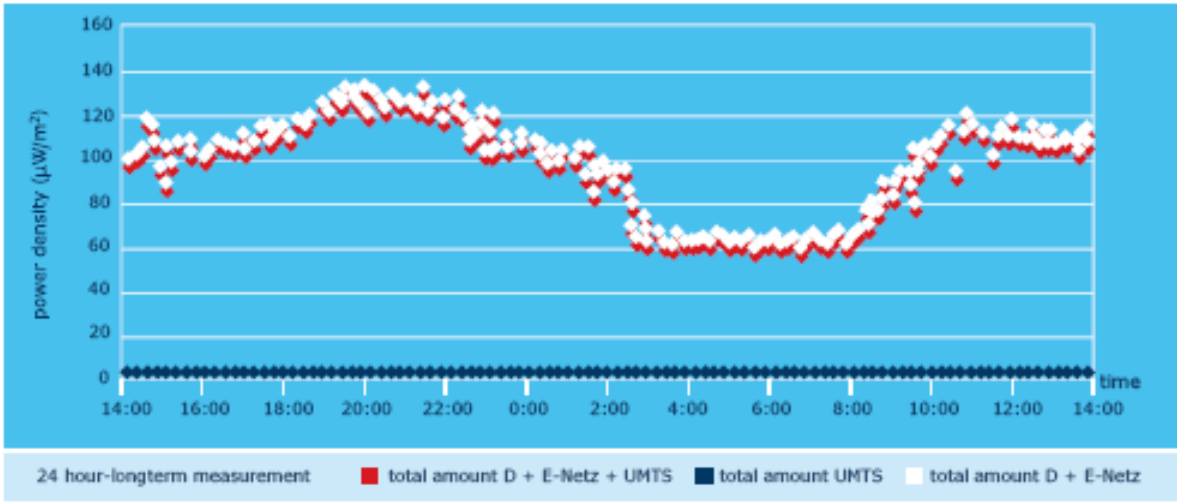


Figure 1. 24-hour long-term measurement in Thuringia.

The readouts also make it possible to deduce basic properties of the EMF distribution of mobile telecommunication emissions. They demonstrate, for example, that the distance from the mobile base station in the immediate vicinity is unsuitable as gauge for the expected field strength. However, determining factors are the differences in height (or rather the orientation to the direction of maximum radiation) as well as visibility conditions. Obstacles in the line of sight such as buildings and even trees dampen the mobile telecommunication EMF. In direct comparison of locations where GSM and UMTS

transmitters operate at the same time, the emission of one or the other dominate according to the local conditions.

The EMF share of the total emissions also varies and depends on the actual conditions at the location. Analyses of DVB-T and DAB transmitters show that their share is at the same level of mobile phone EMF and above. If there is a high-performance VHF transmitter in the vicinity, its emissions are clearly higher than those of the surrounding mobile base stations. Even cordless telephones can develop higher field strengths than cellular phones in living spaces. All measurement results were significantly far below the safety margins, even if other high-frequency EMF sources are included in the considerations.

b) Media reaction

In all participating states the 'Measurement and Information Series' carried out so far has resulted in an exceptionally high and objective media response (382 articles in NRW, 352 articles in Hessen, 395 articles in Niedersachsen and 296 articles in Thüringen) for the entire project duration. Between 4 and 7 million copies of the articles were printed (depending on the size of the state and the circulation of the local daily newspaper.) The measuring procedure becomes transparent for the media representatives who witness the measurements. They can satisfy themselves on site that the measurements are taken correctly and ask questions if they have any doubts. This increases the credibility of the readings significantly and makes sure that the media coverage is highly driven by facts and figures instead of opinion.

c) Events

*Information booth*

Approximately 2,000 visitors visit the IZMF information booth during the one-week informational exhibits. Many are interested in discussing this topic. Attendees are especially interested in the mobile telecommunication specific emission contributions in interiors (such as bedrooms, kindergartens, schools etc.)

*Workshops*

To date approximately 300 participants have participated in the "Workshops for Municipal Representatives and Administrations." Due to the high demand from this target audience, the civic and municipal association has decided to develop the pilot project "Mobile Telecommunication Model Kit" together with the IZMF. The online information tool enables municipalities that have only limited or no online information about mobile telecommunication to design websites according to their own requirements.

The certified advanced training courses for physicians show that the interest in the measurement results by this target group ranks second. Due to their scientific training, physicians are more often able to judge the emissions from mobile telecommunication stations than laity. Their concern focuses mostly on the clinical experience with patients who claim themselves "electrosensitive". Accordant to their feedback the participants, view the brochure accompanying the 'Measurement and Information Series' as a useful tool when dealing with concerned patients.

d) Cooperation

Due to the cooperation between the Ministries for Environment, the government agencies, and the local central organizations, the campaign is well received by the political opinion leaders as well as the general public.

e) Information material

There is a great demand for the brochure (4.000 copies each campaign) from administrations, associations and local governments who use it to educate themselves on the subject of mobile telecommunications. The number of downloads of the online version from the IZMF homepage furthermore confirms that the public's interest in the measuring results continues (e.g. downloads in 2006: NRW 330, Hesse 265, Lower Saxony 444, Thuringia 270).

**Conclusion**

The 'Measurement and Information Series' ('Confidence by Evidence – Examine Mobile Telecommunications') is an efficient instrument of risk-communication. It proves that mobile telecommunications fields in Germany typically are significantly below the safety margin even in close vicinity of the antennas. Due to the focus on typical exposure scenarios, municipal and state authorities can work with the material intensively.

The cooperation with state authorities and participating municipalities ensures high credibility and secures great media interest in the campaign. A high measure of objectivity, which can be evaluated by the tone of the media coverage, is guaranteed by the commitment of independent experts. The cooperation partners of the 'Measurement and Information Series' approve that more confidence and less health concerns about mobile telephony are evident in all federal states where the campaigns has been performed.

# Participation

## Transparency Forum - A Risk Communication Project in Sweden

L. Mjönes and Lena Hyrke
Swedish Radiation Protection Authority
SE-171 16 Stockholm, Sweden

**Abstract**

The rollout of the third generation system for mobile telephony has been fast in Sweden. The decision to build the UMTS system, 3G, was taken in 1999. In spring 2006 the population coverage for the system was over 90 percent. The rapid launching has created concern and opposition among parts of the general population. During 2004 and 2005 the Swedish Radiation Protection Authority, SSI, has arranged the "Transparency Forum", TF, a series of three open seminars regarding the 3G rollout where all stakeholders were involved: authorities, industry and NGOs, including interest groups. The basis for TF is a risk communication model (RISCOM) for delicate situations. A key element in TF is that all stakeholders are involved on equal terms in the planning and realization of the project. The three seminars covered: Roles and responsibilities of the different organisations, the scientific basis for risk assessment and Risk management and precautionary principles. An independent evaluation company evaluated the project. The conclusion was that TF had offered an arena for stakeholders to meet and that the dialogue had been valuable. The evaluators pointed out that it is the responsibility of SSI to carry on working in the transparent way opened up by the TF.

### Recent Risk Communication Activities in Sweden

The Swedish Radiation Protection Authority, SSI, is the competent authority for radiation protection in Sweden, both for ionising and non-ionising radiation. During 2004 and 2005 SSI has made special efforts to inform and educate the public and the municipalities as well as arranging other kinds of dialogue-projects concerning mobile telephony and health. In 2004 a series of six regional one-day training courses, "Mobile telephony and health", was organised by SSI and the National Board of Health and Welfare. The training course was offered to all Swedish municipalities. Altogether more than 300 regional and municipal employees and politicians attended the courses. The response from the attendants has been very positive.

Early the same year SSI took the initiative to a network of experts on mobile telephony and health in the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. The work in this group resulted in a common position paper "Mobile Telephony and Health" (1). In short the Nordic authorities pointed out that there is no scientific evidence for adverse health effects from mobile telecommunication systems, but that some scientific uncertainty and knowledge gaps could justify a precautionary attitude regarding the use of handsets for mobile telephony.During 2004 and 2005 SSI, arranged the "Transparency Forum for mobile telephone systems", TF, a series of three open seminars regarding the 3G-system rollout where all stakeholders were involved: authorities, industry and NGOs, including interest groups. The basis for TF was a risk communication model (RISCOM) for delicate situations. A key element in the RISCOM model is that all stakeholders are involved on equal terms in the planning and realization of the project.

The three seminars in TF covered: Roles and responsibilities of the different organisations, the scientific basis for risk assessment and Risk management and precautionary principles. This paper describes the Transparency Forum in more detail.

**The process of defining the project**

The rollout of the third generation system for mobile telephony has been fast in Sweden. The decision to build the UMTS system was taken in 1999. The licences for the operators were distributed in 2000. In spring 2006 the population coverage for the system exceeded 90 percent in Sweden. The rapid launching has created considerable concern and opposition among certain parts of the general population. The media coverage of the 3G-rollout issue has been intensive. Interest groups have been active in the resistance towards the launching of the new system and sabotage against masts carrying UMTS base stations has occurred. Also, individuals that have reported a variety of health problems that they relate to exposure to electromagnetic fields have argued that the authorities have neglected their problems. The debate at the municipal level has been intensive, involving local civil servants as well as local politicians. The building of masts has been appealed in court etc. SSI and other central authorities, have received critical views concerning the authorities' role in the controversy on new mobile phone technologies. One reason for this is the perceived technocratic approach that is no longer accepted. The need for a dialogue was obvious.

**The RISCOM model of transparency**

For more than 15 years, SSI has been working with risk communication in the nuclear waste arena, trying to achieve a better dialogue between different stakeholders. Using this risk communication experience and methodology, SSI has been co-financier in the development of a communication model for dialogue in different areas of complex issues of society – RISCOM (from RISk COMmunication). One suggestion of the RISCOM approach is to create an arena for dialogue and discussion for concerned parties (2,3,4).

Decisions on certain complex issues, for instance regarding nuclear waste management, involve both scientific/technical and value-laden parts. If this is evident, transparent, both to the public and the decision-makers the decisions taken will generally improve in quality. It is also important that all parties understand the roles and responsibilities of the different stakeholders.

According to the RISCOM model, appropriate procedures must be created in which the decision-makers and the public can validate claims of:

- Truth (technical-scientific issues: Is this true? Are we doing things right?
- Legitimacy (normative issues: What is fair, acceptable, legitimate)
- Authenticity (trust, no hidden agendas, personal integrity and organisational identity)

These are the three cornerstones (often illustrated as a triangle) in the RISCOM concept they are equally important and interconnected.

It is seldom possible for the public to understand the scientific and technical issues in detail, or for the different scientists and experts to understand the details of each other's disciplines. Therefore, appropriate decision processes must be created; allowing the

public to judge whether they can trust different scientists and experts. The public, and other stakeholders, must have the opportunity to evaluate the trustworthiness and authenticity of all parties involved. An important and useful tool to evaluate Truth, Legitimacy and Authenticity is the concept of "stretching". Stretching usually means that critical questions are raised from different perspectives and answered. All involved parties must allow themselves to be stretched. Public participation is essential for transparency and a satisfactory public involvement is not possible without transparency. The media is also important in a transparent process. Experienced journalists are vital for 'stretching' scientists, experts, and authorities, but they must allow to be stretched too.

The RISCOM concept has been successfully applied in the nuclear waste management discussions in Sweden.

**Transparency Forum**

During 2004 SSI initiated a dialogue project outline on the launching of the third generation of mobile telephony, the "Transparency Forum for mobile telephone systems". The aim of this project was to improve the dialogue and transparency in society regarding electromagnetic fields, focusing on new mobile telephone systems, and to increase the mutual understanding of different stakeholders' roles and value judgements, so that different discussions will be addressed in the right arenas (political, technical, municipal etc.).

All kinds of relevant stakeholders have taken part in the project; authorities, industry and NGOs, including interest groups. All were given the opportunity to express their opinions and ideas since a key element in RISCOM is that all stakeholders are involved on equal terms in the planning and realization of the project.

**The reference group**

A reference group was created, with a broad representation of the relevant stakeholders. The reference group did, at a series of regular meetings, take decisions on defining the process, program, timetable, meeting places, etc. A requirement for the Transparency Forum concept was that the project was to be defined and decided by this reference group, and not by SSI alone. The RISCOM principles were used all the way as the structure for dialogue. Swedish authorities financed the project and SSI was the project manager, also using consultant experts.

A number of preparatory meetings were held to define the need for a dialogue process, starting with representatives from two municipalities experiencing a debate concerning the implementation of new mobile phone technologies. The municipal interest was very high, leading to widened meetings with other stakeholders, also approving the initiative (other authorities, municipal representatives, industry, NGOs, etc.). Therefore, a reference group with a broad range of stakeholders was established to define the Transparency Forum project. A project outline was created, that has been updated and accepted by the reference group, along with a formal agreement specifying the conditions for participating.

Organisations represented in the reference group:

Authorities
Swedish Radiation Protection Authority
National Board of Health and Welfare
National Electrical Safety Board
Swedish Work Environment Authority
National Post and Telecom Agency
National Institute of Public Health
Swedish Emergency Management Agency
Stockholm County Council (Medical expertise)
Nacka and Södertälje municipalities

Industry
Ericsson
MTB (Organises manufacturers and dealers of mobile phones)
Tele2 (Network operator)
TeliaSonera (Network operator)
Vodafone (Network operator)

NGO's
TCO Development (Labelling of mobile phones and other electronic products)
Vågbrytaren, Swedish for Breakwater (Interest group fighting unhealthy electromagnetic radiation)
FEB, Swedish Association for the Electro hypersensitive

**Three interactive seminars**
During the project preparation it was decided that three seminars should be organised where it would be possible for all stakeholders to state their true opinions and be questioned on their views by all others. The reference group decided on the following themes for the three seminars:

*Seminar 1 - The roles and arenas of the different stakeholders*
This first seminar was held late in 2004 and about thirty people attended. The seminar gave a description of the historical evolution of the new mobile telephone systems, focusing on decisions in political, technical, and economical areas that have led to the present situation.

To create a dialogue people have to meet, and be given the opportunity to understand other stakeholders' roles and responsibilities. Several Swedish national authorities are more or less involved when it comes to the question of UMTS, and the roles and interactions of these are not always easily understood. Therefore, a description of the interaction between different stakeholders and arenas was designed. Representatives for the involved authorities, industrial companies and NGOs gave accounts of their different views on the mobile telephone issue. A Member of Parliament representing the Green party presented that party's view.

After the presentations a number of interesting questions that had appeared during the day were discussed in working groups. Some of the questions were:

- How can Society take better care of people who claim to be electro hypersensitive?
- How can the precautionary principle be applied to mobile telephony?
- Who has the responsibility for weighing risk against benefits of new techniques?
- How should anecdotic reports and personal experiences be taken into account in the risk estimation process?

The discussion in the groups were loud and vivid, but were held in a good mood.

*Seminar 2 - The research basis for the risk estimation*

The second seminar was held for two days early in 2005 and about sixty people attended. The scope of the seminar was to discuss the research in the area of radiofrequency electromagnetic fields and health as a basis for the risk estimation for mobile telephony. Risk evaluation and judgment is not a strictly technical and scientific issue, values also plays a very important role. It is important to understand how we, as individuals, perceive risks and makes personal risk judgments. The second seminar was therefore planned with a broad framing where the themes of discussion were:

- Radiation – physical and biological facts and risk estimations for electromagnetic fields
- Risk estimation concerning mobile telephone systems
- Different methods for risk estimation
- The basis for SSI´s risk estimation and regulations for electromagnetic fields
- The situation for individuals who find themselves hyper-sensitive to electromagnetic fields

Among the participating scientists were Anders Ahlbom and Maria Feychting from the Karolinska group, Lennart Hardell from Örebro University, Jacob Eberhardt from Lund University (the Salford-Persson group) and Igor Belyaev from Stockholm University. Lars-Erik Holm, director general of SSI presented the authority's risk estimation for exposure from mobile phones and from base stations. Representatives for the industry and the interest organisations presented their respective views on the risks. The discussions and stretching after the presentations were intensive and sometimes rather aggressive

Also at the second seminar discussions in working groups were an important part. The group discussions were held at the end of the first day. A specific scope this time was that the groups should present questions that could be used for the stretching the next day. Four groups were formed:

1. Research on health risks from base stations and antennas
2. Research on electrical hypersensitivity
3. Risk estimation procedures
4. Research, methodology and evaluation

The working groups were successful in formulating a number of relevant questions for the stretching

*Seminar 3 - Precautionary principles and exposure limits*
The third and last seminar, also for two days, was held in spring 2005 and about a hundred people attended. The scope of this seminar was to discuss precautionary principles and exposure limits as applied to mobile telephony. Precautionary principles are used in many different areas and there are many different interpretations on the practical use and consequences. The precautionary principles relate of course to the use of exposure limits for electromagnetic fields.

Themes to discuss were:

- Legal aspects of exposure limits and the precautionary principle (EU and national legislation)
- Exposure limits for electromagnetic fields
- Different interpretations and practical implications

The seminar began with a very interesting presentation on the background and the legal aspects of the precautionary principle by Annika Nilsson, legal expert from Lund University. Maila Hietanen, vice chairman of ICNIRP (International Commission on Non-Ionizing Radiation Protection) presented ICNIRP's work and the 1998 guidelines. Igor Belyaev gave an account of the guidelines from RNCNIRP, the Russian commission on non-ionizing radiation protection. The proposal from the WHO EMF Project for a Precautionary Framework was also presented. The second day concluded with a panel discussion focussed on exposure limits and how to apply the precautionary principle.

At the beginning of the second day the Swedish Minister for the Environment, Lena Sommestad, gave the Government's view on precautionary principles and exposure limits applied to mobile telephony. Lars-Erik Holm gave an account of the scientific basis of SSI's risk estimation and exposure limits. He also presented the role of SSI's international expert group on electromagnetic fields (5). After that other central Swedish authorities involved in mobile telephony: the National Board of Health and Welfare, the National Electrical Safety Board and the Swedish Work Environment Authority gave their views on the risk estimation.

A representative from Stockholm municipality discussed the rights of those who claim to be electrically hypersensitive and the industry and the NGOs in turn presented their views on the risk estimation. The second day of the seminar concluded with a questioning of some of the speakers and a panel discussion.

**The evaluation of the project**

To investigate whether the aim of the project was fulfilled, an evaluation was made by an external company specialised in evaluations of different authorities dialogue projects. The evaluation method that was used included different kinds of interviews and telephone questionnaires. Special care was taken to make sure that as many of the project's participants as possible took part in the evaluation. It was also important for the credibility of the evaluation that personal opinions should be taken into consideration and analysed. A special focus was therefore put on subjective impressions of both the project's accomplishment as well as the effects of the project.

The evaluation clearly shows that the majority of the participants have the distinct opinion that the project has resulted in an improved dialogue of the UMTS issue. The project has contributed to that the stakeholders have been sitting at the same table actually meeting each other's different opinions and views in a way that not had occurred in Sweden prior this project. There have also been different forms of learning and a new forum for dialogue has been created. Due to the meeting between different stakeholders with different opinions and values there has been an increased understanding for other stakeholders' roles and values. The project did not have as an aim to reach consensus (6).

**The final report**

During the entire project the documentation of the process has been of the greatest importance. Some parts of the seminars have also been recorded to make sure that all aspects of the interesting discussions were not lost in mere notes. It was stated already in the beginning of the project that the documentation would result in a final report. The idea was that this report would try to capture the very essence of the Transparency Forum, the dialogue itself. The report is being written not only for the participants of the project but also for all those who did not have the opportunity to participate in the project, of for example geographic reasons. The report is expected for release in autumn 2007.

**How is the dialogue continued?**

Originally there was an ambition to continue the dialogue of Transparency Forum in a more permanent way, as a regular part of the work of SSI and other stakeholders. But in December 2005 the project was concluded and the reference group resolved. The evaluation points out that it is important to continue the dialogue. The question is how. For this there are no readymade plans as of today, but SSI is determined to continue the work that has been started. SSI has the intention to summon the stakeholders regularly to discuss different aspects of electromagnetic fields and health in order to maintain the dialogue.

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# The Bavarian "Mobile Phone Pact" as a Framework for the Participation of Communities in the Siting of Mobile Phone Base Stations

Evi Vogel
Bavarian Ministry of the Environment, Public Health and Consumer Protection

## Introduction

Nowadays in Germany there are more contracts for mobile phones than inhabitants. Although clear legal frameworks regarding limit values do exist in Germany as well as building laws and the supervision of these laws, public protests concerning the siting of mobile phone base stations are quite common. Therefore state authorities get more and more involved in discussions about precautionary measures. Such measures may include e.g. public participation in the siting of base stations, more information on health effects and research. The mobile phone providers consequently signed two declarations in 2001 to promote more information for the public and to allow for participation in the siting of mobile phone masts. However, if no platform and frameworks for implementation are defined, it is very difficult to check the results and the advance.

## Precursors of the mobile phone pact

As protest in the southern parts of Germany has been on a higher level than in the rest of Germany frameworks for participation have been developed and promoted much earlier than on the federal level.

In Bavaria a first contract between the mobile phone providers and the state of Bavaria has been signed in 1999 under the umbrella of a wider environmental treaty in order to give it more impetus. Since then providers informed the "planning regions" (districts of Bavaria having the same regional planning) once a year about new plans for siting, sharing sites (with fixed percentages) and holding information campaigns together with the state.

In 2001 another treaty was signed between the mobile phone providers and the state of Bavaria, this time it was a pilot project including 60 smaller communities and 6 bigger cities, which took part in a project testing the possibilities of how to include the communities in the siting. The pilot project on participation was accompanied by measurement campaigns because the optimisation of a site should include the exposure situation. However, exposure is only one factor for optimisation, other factors should include public opinion, vicinity to schools, kindergartens or hospitals, availability of alternative sites and technical feasibility. After the test phase a workshop was held with the participating communities, it was concluded that participation should be implemented for all of Bavaria.

## The "Mobile Phone Pact"

Therefore after the pilot phase the mobile phone providers in Bavaria, the Association of the Bavarian Local Authorities, the Association of the Bavarian Counties and the Bavarian state government in 2002 signed an agreement. This so-called "Mobilfunkpakt" ("Mobile Phone Pact") allows the communities to participate in the siting of mobile phone stations and contains additional commitments of the providers and the Environmental Ministry, which help to make the siting of antennas more transparent.

The main content of this pact is the framework of how to organize participation in the siting of mobile phone base stations. Whenever a provider looks for a new site, he now has to write to the respective community first and give information about the planning and the approximate location of the new site. Then it is the decision of the community if they want to engage in the decision process or not. If they do not want to engage, the provider will find a lessor on his own, if they do engage, they may suggest up to three options for the site, which then have to be checked by the provider. In cities with more than 50 000 inhabitants this process is done in round table discussions, involving the main stakeholders, often also representatives of interest groups. They usually discuss more than only one site. In smaller communities the timeline for a dialogue process between the community and the mobile phone providers is included in the pact.

In order to support this process the Bavarian Environmental Ministry launched a promotion project for measurements before and after siting. In addition, the Ministry and its regional offices have also published specialised information material (e.g. brochures on how to minimize radiation by choosing appropriate sites or brochures on how to achieve additional shielding). More general measurement campaigns as well as studies, education campaigns and public talks add to transparency and acceptance.

**Commitments of the providers within the pact**

For Communities > 50 000 inhabitants:

- Set up of round table with stake holders
- Continuous dialogue about roll out
- Planning and stage of roll out is published regularly
- Working group goes into details
- Public is informed regularly

For Communities < 50 000 inhabitants:

- Provider informs community about new planning
- Community considers involvement within 30 days
- If decision is positive: 60 days for suggesting own sites
- Providers have to check max. 3 suggestions
- If suggestion qualifies: site is built
- If suggestion does not qualify: rejection with explanation
- Final discussion round within 1 month

**Commitments of the State of Bavaria**

- State properties may be used for antenna sites (simplified contracts)
- Information efforts of the Bavarian Environmental Ministry:
    - Training of environmental engineers employed by the State and medical doctors working in State health centres
    - Telephone hotline for questions from the public
    - Information material is prepared and distributed
    - Talks are given

- Projects on EMF are funded, e.g.

  - Monitoring campaign (in 400 statistically selected sites in Bavaria, low frequency and high frequency spectra are measured, report on first campaign 2002/2003 http://www.bayern.de/lfu/laerm/emv/index.html, second campaign will be completed in 2007)
  - Accompanying measurements in communities where new sites are to be built (10% paid by communities, 57% by providers, 33% by State)
  - School project (see contribution to "educational projects" in this volume)

**Results**

Since then the yearly reports show that the pact partners all in all are content with the results the pact achieves. The pact was extended in 2004 for another 3 years, as only about 10 % of the base-stations were built without consent of the community after the pact was introduced. A poll in spring 2007 among the communities (there are about 2000 independent communities in Bavaria) showed that more than 80% of the communities want the continuation of the pact without changes. Another result was that 87% of the communities have no or little problems with siting. Consequently the Pact was renewed for 4 more years in Nov. 2007 after consultation with all Pact partners and agreements on further improvements of the procedure.

In Bavaria the general level of protest against mobile phone base-stations is slowly decreasing, however some very dedicated activist groups produce really hot hotspots every now and then.

Further Information:

At www.elektrosmog.bayern.de (Internet page of the Bavarian Ministry of the Environment, Public Health and Consumer Protection) you may find:
a) The text of the pact as well as the conditions for the measurement project linked with the pact in the section: "Mobilfunkpakt II und FEE-2 Projekt".
b) The German ordinance on electromagnetic fields (26. BImSchV) in the section "Rechtsgrundlagen".

At http://www.lfu.bayern.de/strahlung/fachinformationen/index.htm (Internet page of the Bavarian Environment Agency) you may find the report about the EMF monitoring campaign 2002/2003. The report for the campaign 2006/2007 will be added as soon as completed in the section "EMF-Monitoring in Bayern".

At http://www.bfs.de/elektro/papiere/umfrage2005.html (Internet page of the German Federal Office for Radiation Protection) you may find the results of the 2005 opinion poll on mobile telephony.

# The Dutch Model: Public Participation in the Installation of Mobile Phone Towers

Rogier Brink
Antenna Bureau, Netherlands Radio Communications Agency
Anke Stapels and Ginevra Delfini
Ministry of Housing, Spatial Planning and the Environment

## The Dutch Policy on Mobile Phone Towers

The main tenet of the Dutch Mobile Phone Tower Policy is as follows: '*The Dutch government wishes to guarantee that there is sufficient space for the installation of mobile phone towers, as long as they do not jeopardise public health, the environment and public safety.'*

What this means is that once safety and public health concerns have been reviewed and the government is certain that the installation of mobile phone towers will not pose a threat to public health, it will facilitate the installation of such towers. Therefore, the government has made it easier for mobile operators to erect towers, as long as they give the public a say in the matter, so as to promote public participation.

## The Dutch Participation Model

When the government's policy on mobile phone towers came into force in 2002, mobile phone towers were divided into two groups:

- Large towers, which require a building permit
- Small towers, which no longer require a building permit

Under the current housing act, mobile operators need to apply for a building permit with the local authorities if they wish to erect a mobile phone tower over five metres in height. The permit they need to obtain is the same permit that governs other forms of construction, which means local residents may oppose it, just like they have the right to oppose the construction of new buildings in their neighbourhood. However, only a relatively small percentage of mobile phone towers requires this kind of permit. Most mobile phone towers erected in the Netherlands (80 per cent of the total number) are fairly small, meaning less than 5 metres in height and situated on rooftops rather than freestanding. The installation of such small towers no longer requires a permit. However the owner of a building has to approve plans to erect a tower on his rooftop. In this way the Dutch government has made it easier for mobile operators to install their towers.

## Approval Procedure

What happens if a mobile operator wishes to erect a mobile phone tower on top of a block of flats? Needless to say, the operator has to consult the owner of the building, but that is not all. Under the agreement the Dutch government has entered into with mobile operators, an approval procedure is called for if a mobile phone tower is to be erected on top of a building with tenants.

What this means is that if a mobile operator wishes to erect a mobile phone tower on top of a building, which has tenants, these tenants must be consulted. The procedure is explained in great detail in the Dutch Mobile Phone Tower Agreement. First of all, the operator has to obtain the owner's permission. Then all the tenants of the building receive an information package, which also contains a ballot. The information package provides general information on mobile phone towers and the Dutch government's policy on such towers. It goes on to explain that a mobile operator would like to erect a mobile phone tower on the tenants' building, and invites the tenants to return the ballots they have received to vote either in favour of or against the installation of the tower. If more than 50 per cent of the tenants oppose the installation of the tower, it will not be installed. To ensure the impartial character of the approval procedure, the full procedure, including the counting of the votes, is run by an independent research agency.

**The Dutch Participation Model: Five Years' Worth of Results**

At the May 2007 Stresa conference, the Dutch government presented a poster showing the main results of the 'participation model' (the approval procedure), which had then been in use for five years. You can see those results in the tables below.

Figure 1 shows that since the start of the project in 2002, mobile operators who sought to gain the locals' support for their plans have started about 700 approval procedures. In all, some 50,000 homes received information packages and were invited to vote on the issue. 78 per cent of the procedures were successful in that the installation of the mobile phone towers was approved.

| Approval procedures | 2002 (from June onwards) | 2003 | 2004 | 2005 | 2006 | 2007 (1 Jan - 13 Feb) |
|---|---|---|---|---|---|---|
| | | | | | | |
| Number of approval procedures | 17 | 289 | 187 | 106 | 95 | 9 |
| Number of approval procedures with positive result | 13 | 238 | 158 | 67 | 68 | 6 |
| Percentage of approval procedures with positive result | 76.50% | 82% | 84.50% | 63% | 72% | 67% |
| Number of approval procedures with negative result | 4 | 51 | 29 | 39 | 27 | 3 |
| Percentage of approval procedures with negative result | 23.50% | 18% | 15.50% | 37% | 28% | 33% |
| | | | | | | |
| Total number of forms sent | 939 | 23826 | 14056 | 7474 | 7484 | 633 |
| Total number of forms returned | 494 | 7484 | 5795 | 3646 | 3084 | 297 |
| Total number of votes in favour | 100 | 2181 | 1699 | 571 | 549 | 88 |
| Percentage of votes in favour (of forms sent) | 11% | 9% | 12% | 8% | 7% | 14% |
| Percentage of votes in favour (of forms returned) | 20% | 29% | 29% | 16% | 18% | 30% |
| Total number of votes against | 335 | 4284 | 3409 | 2596 | 2361 | 208 |
| Percentage of votes against (of forms sent) | 36% | 18% | 24% | 35% | 32% | 33% |
| Percentage of votes against (of forms returned) | 68% | 57% | 59% | 71% | 77% | 70% |
| Total number of invalid votes | 59 | 1019 | 687 | 479 | 174 | 1 |
| Percentage of invalid votes (of forms sent) | 6% | 4% | 5% | 6% | 2% | 0% |
| Percentage of invalid votes (of forms returned) | 12% | 14% | 12% | 13% | 6% | 0% |

Figure 1: The Dutch Participation Model, 2002-2007

The information in figure 1 shows the fact that there were far more procedures in the early years than there have been recently. The years 2003 and 2004, notably, saw considerably more procedures being started and ballots being returned than has been the case lately. Since 2004, the number of procedures has gone down considerably. This trend can also be observed in figure 2.

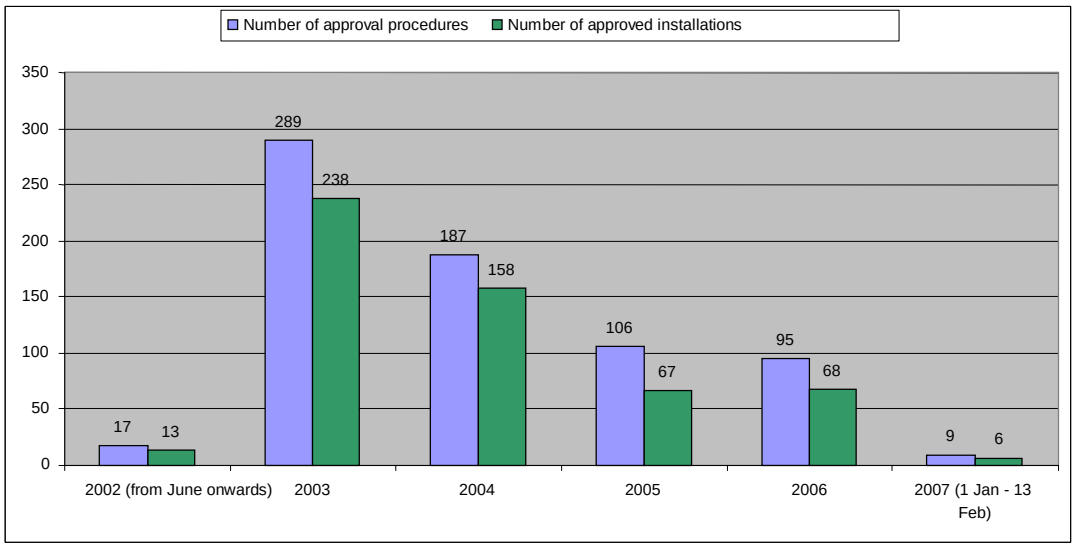


Figure 2: Number of Procedures Versus Number of Approvals

Likewise, the percentage of procedures that resulted in the actual installation of mobile phone towers was higher in the early years than it has been in recent years. In 2003 and 2004, over 80 per cent of the procedures resulted in the towers being erected, whereas in later years, the figure dropped to approximately 70 per cent (see also figure 3).

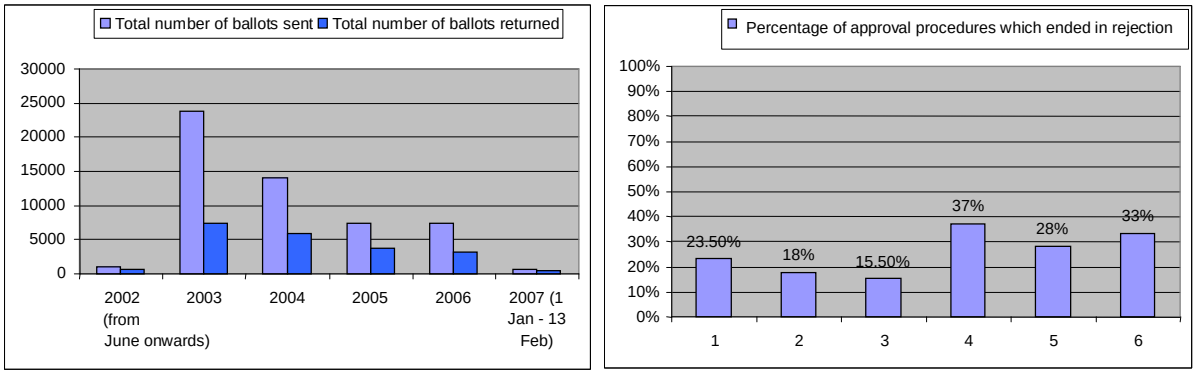


Figure 3: Number of Ballots Returned and Number of Rejected Installations

Another striking finding of the data comparison was the high number of invalid votes cast during the early years of the procedure. During the first four years in which the procedure was observed, over 10 per cent of the votes cast were invalid. An investigation carried out by the Dutch government in 2006 revealed that the design of the ballot was perceived to be unclear by many users. This caused them to complete the form incorrectly, which then resulted in their votes being declared invalid. In order to improve the situation, the ballot was revised later in 2006. Since then the number of invalid votes has decreased significantly, to approximately 0 per cent in 2007 (figures 4 and 5).

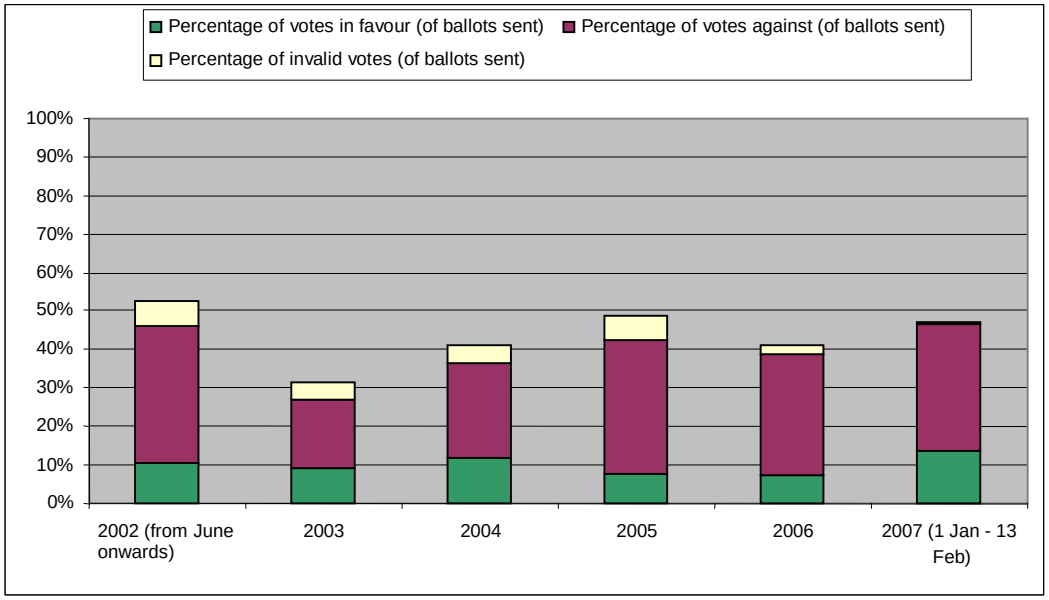


Figure 4: Voting Results over the Years

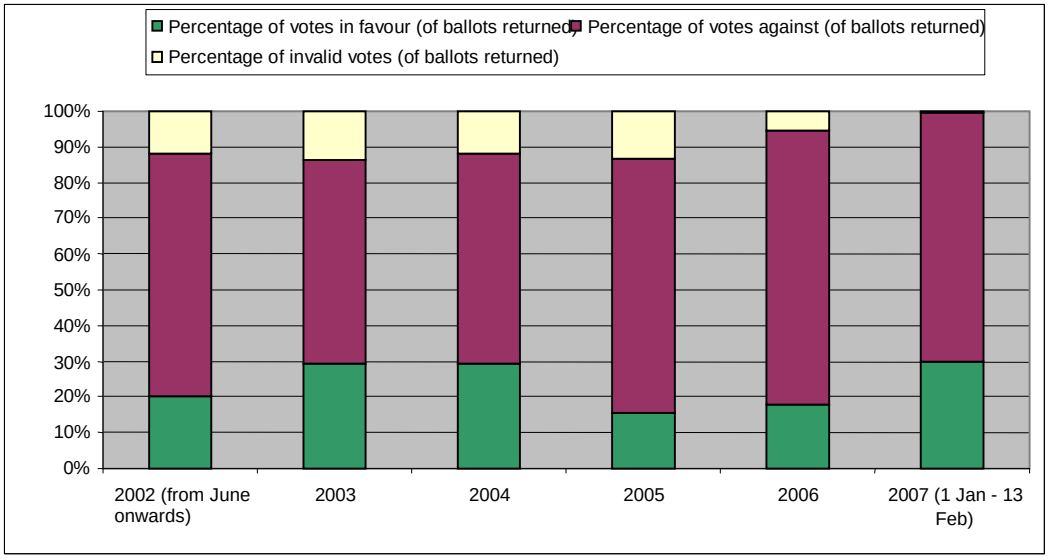


Figure 5: Voting Results over the Years

**Conclusions**

It is hard to draw a validated conclusion from the figures at hand for this paper at this conference. The tables you have seen were included mainly for the benefit of the audience, to illustrate certain facts. They have not been thoroughly analysed. Yet they can help us draw certain conclusions.

We can infer that only a minority of those consulted were sufficiently interested in the installation of mobile phone towers on the rooftops of their buildings to voice their opinions. In 2003 and 2004, only 30 per cent of those consulted returned the ballot that gave them a say in the matter. Afterwards, the number went up to approximately 50 per cent. The increased response percentage went hand in hand with an increase in opposition to the installation of the towers. Still, the percentage of those who objected never exceeded 35 per cent, not even during those later years.

It is obvious that the Dutch approval procedure met a significant need on the part of mobile operators, especially during the first few years it was in place. Many operators used the procedure. Relatively few residents opposed the installation of the towers, so the great majority of the procedures resulted in the mobile phone towers being erected as planned. In later years, more people voiced their objections, whereas the number of approval procedures started decreased. We are not sure whether those two facts are connected. It is possible that the need for approval procedures simply decreased because mobile operators needed fewer installation sites. However, it is equally possible that mobile operators were less inclined to consult the locals because they were expecting resistance. We have not looked into this matter.

What we can say at this point is that the approval procedure granted over 50,000 people in the Netherlands the opportunity to vote on the installation of mobile phone towers on top of their buildings, and that over 20,000 of them used their right to do so.

**Acknowledgement**

This paper was presented at the meeting in Stresa, May 2007, and it is a joint production of the Dutch Antenna Bureau, The Ministry of Economic Affairs and the Ministry of Housing, Spatial Planning and the Environment.

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4. Adjustment Housing Act, 8 August 2002.

5. New Voting Ballot, June 2006.

All of these documents can be found at the websites:

www.antennebureau.nl
www.vrom.nl/umts-antennes
www.minez.nl

## Public Participation in Technology Evaluation and Risk Communication

Horst-Dietrich Elvers and Christof Tannert
Unit Bioethics and Science Communication, Max-Delbrueck-Center for Molecular Medicine (MDC) Berlin-Buch, Robert Roessle Str. 10, 13125 Berlin, Germany

**Summary**
This paper discusses public participation as a means of risk communication. It argues that the involvement of the broader public is a prerequisite to identify demands for societal consensus building, regarding new technologies, which potentially might impact human health. In this paper we will start by outlining the social context of participative technology evaluation and risk communication. We will then demonstrate that public consultations are manageable and feasible, not only in clarifying the public's position to future technological trends with ethical relevance, but also with respect to the assistance in defining research priorities and needs for more focused risk communication. Finally, we will sketch an online-based discourse, which is implemented in order to gather stakeholders' perceptions and opinions on knowledge gaps in RF-EMF cancer risk assessment.

### The social ecology of health and the need for risk communication

In contemporary industrial societies, health risks resulting from serious environmental damages and new technologies have replaced most of the diseases of ancient times, such as for instance cholera, pest, and typhus. The notion of the "risk society" (Beck 1992) has picked up this development early, by stressing that dangers to society nowadays are mainly caused by society itself. With some exceptions, e.g. in approaches of Latin urban planning[1], in former times health and illness have been ascribed to some sacrificed "nature" or the transcendental power of divinity, but were not recognized as within the responsibility of humankind for generations. With dramatic societal and demographic changes, which perhaps began with the Enlightenment and manifested in secularisation, industrialization, population growth and an enormous technological progress in the last two centuries, the "environment" substituted what was formerly called "nature". Thereby the self reflection of humankind as being condemned to an everlasting anthropocentric fight against nature in order to survive was slowly replaced by a more diversified understanding of the complex interaction of humans and the eco-system.

The strong dependency of individual health from the social-ecological conditions was most forcefully realized by the emergence of social hygienic approaches in the 19$^{th}$ century, and further in the 20$^{th}$ century, when Public Health appeared as a crosscutting discipline combining social and medical sciences. Since its early days, one central topic of Public Health has been the influence of the environment on human health. In a way

[1] The Latin Vitruvius Maximus (perhaps 80/70 B.C - 25 B.C.) influenced the architecture of his time, as well as the renaissance. He inspired the *Vitruvian Man*, by Leonardo da Vinci. According to Vitruv, architecture is not only about constructing, but has also to consider parameters for healthy buildings (mainly regarding ambient air and water quality). (Sources: http://en.wikipedia.org/wiki/Vitruvius, (Rodenstein 1988).

inverting the perspective of humankind damaging the environment, it focuses on the feedback of the anthropogenic changed environments on human health.

This ecological perspective on human health has two major, inter-linked implications: Firstly, human health depends to a large extent on how humans "behave" with their physical and social environment, and how they modify it by exploiting it for purposes of welfare. Secondly, the more the human-environment interdependency impacts human health, the more important it becomes to realize the possible consequences of both ones' own behaviour and technological developments. Mainly the second implication is encompassed by a stream of risk research, which focuses on the communication of available scientific knowledge to the public, in order to foster the understanding of risks and enable individual behaviour towards a conscious and sustainable use of technologies, esp. when there are scientific uncertainties about their potential to induce adverse health effects.

One objective of risk communication besides the task to warn the general public in times of health crises is to inform the public about how environmental pollutants act and thereby supporting individuals in protecting themselves against potential adverse health impacts. However, it is localized in a space between well-established health risks, with enough evidence to prevent serious harm on the one hand, and possible adverse effects to human health, which have not been excluded yet, on the other. Mainly regarding possible health effects of, e.g., chemical compounds in products of everyday use, or building materials, much knowledge exists about the potential of specific substances to cause certain diseases, but less is known e.g. on how they act in combination with other chemical substances.

Thus, even in the case of known toxins, science is facing uncertainties related to the combined effects they may unfold in products of everyday use. This principal uncertainty, even in the interpretation of the results of positive science, is a strong challenge to science communication between experts and the general public. The dream of increasing human control over the world in order to re-structure it for purposes of civic welfare by means of scientific progress, has been substituted by a, as sociologists call it, "produced uncertainty" (Beck et al. 1994, 317). These uncertainties seriously challenge the modern paradigm of scientific research to gather knowledge in order to provide society with objective information. Therefore, in order to encounter scientific uncertainty and complexity in environmental and health issues, it is proposed to involve wider circles of people in decision making and implementation on policy issues, which is called "extended peer communities" (Funtowicz and Strand 2007): "Their common feature, however, is that they assess the quality of policy proposals, including a scientific element, on the basis of the science they master combined with their knowledge of the ways of the world." (ibid.).

This mode of proactively coping can also contribute to risk communication, which is more than just informing the public about potential risks. As the term "communication" already implies, it should as well be understood as an interactive dialogue on the potential consequences of both personal habits and societal developments, which are not predictable in any detail. Within that scope, risk communication has also to inform on the limits of science. To our understanding, public participation is an essential part of these processes of mutual feedbacks.

**Public involvement in technology related decision-making: examples**

The diffusion of approaches to participate the public in political decisions on technological innovations is increasing. Although there is still criticism concerning the involvement of non-experts, participative approaches are in the focus of applied technology assessment (c.f. Abels and Bora 2004; Tannert and Wiedemann 2004; Bora and Hausendorf 2006). In general, the consultation of the public is practiced to ensure that decisions referring to the regulation of new technologies are both understood and broadly accepted, but it could also be realized as a societal discourse on the desirability of new technologies. Put into practice, public participation can support policy analysis in terms of *preparation activities* for decision making, they can be more directly linked to the *decision-making* itself, as is with calls for the public to vote on certain issues or they are predominantly intended to stimulate *public debates* (Joss 1999). Consequentially, there are a large variety of different methods to be used. Although they all have in common that they are intended to take into account the perspectives and values of different interest groups in assessing the need for, and impacts of, new technologies (Hennen 1999, 304), they differ by means of the addressed social groups, the complexity of the issues at stake, the actual range of the involvement (which reaches from information measures, via public hearings to the inclusion of publicly gathered opinions in the decision to be made), and – last but not least – the true motives of their implementation: are they really intended to enhance political decision making or are they simply pretending deliberative rituals?

The more new technologies are discussed in the lights of potential adverse consequences on human health, the more become both information and risk communication necessary objectives of participatory approaches to technology evaluations. Democratic societies have ever pretended to be committed to public participation, which in this sense was a more or less ubiquitous matter of course. However, the emergence of the "risk society" (Beck 1992) and the notion of the "reflexive modernization" (Beck et al. 1994), revealed that the involvement of the public in decision making has become a *functional prerequisite* for the societal self-conception in recent times, referring to technologies and their, both desired and undesired, consequences. Therefore, the most urgent need for the public to participate in decision-making is uttered in those fields of new technologies that bother basic, so far considered *self-evident*, readings of the human entity.

Among those, the most controversial debates evolve around the promises and perils of genetic medicine, which has given birth to public controversies regarding the plasticity of the human development. These refer not only to predispositions towards certain diseases, but also are related to fears towards a "designing" of humans. Some questions that have to be answered in the near future include how far-reaching genetic screening may be. Further: Is there "worthless life" because of "bad genes"? Which genetically determined individual attributes are to be excluded from diagnostic screening, in order to avoid misuse and eugenic tendencies? Although currently the expectations towards gene therapies are far beyond the scientific possibilities, some barrages are already broken down. The UK Human Fertilisation & Embryology Authority (HFEA), on the one hand, has published a list with conditions that were licensed for PGD[2]. In Germany, on the other

[2] Download: http://www.hfea.gov.uk/en/495.html, note that some extremly rare conditions, that are also licensed, have not been included on this list as their inclusion could lead to the identification of the patients concerned.

hand, in-vitro genetic diagnostics of embryos are not practiced[3] but in-vivo testing (pre-natal diagnosis) is exercised and may legitimate an abortion due to medical indications on behalf of mother's health, even after the 12th week of pregnancy.

The application of PGD in embryos is inconsistently regulated in different countries across Europe (Nippert 2006). Admittedly, the United Kingdom has one of the most liberal, though clearly regulated systems, regarding both research and application of biomedicine. However, the British government has uttered special need for public involvement in particular with respect to the future development of science (House of Lords Select Committee on Science and Technology 2000). Consequentially, public participation has been increasing throughout the past years in the U.K. There have been numerous consultations alluding issues of ethical relevance[4], and some are closed and have been evaluated yet, whereas others are still ongoing. Nevertheless, a standard methodological procedure that is agreed upon is lacking. On the one hand, there are public consultations including surveys covering over 2.000 respondents, representative for the U.K. (e.g. the HFEA consultation on sex selection)[5]. On the other hand there have been consultations gathering only 171 responses in order to provide input for expert's panels that then made recommendations (e.g. the HFEA consultation on the future of PGD in the year 2000). Compared to the sex selection consultation, experts were given more weight in the assessment of limits and opportunities.

A further crucial point in each consultation procedure, besides the methodological set up, is the power the consulted arguments are given. Concerning the public consultation of sex selection, contrary to the former opinion of the HFEA experts, the majority of the public decided to not legalize it for other than medical reasons. The HFEA finally advised *in line with the public opinion*. After this decision, there has been criticism concerning the way in which the HFEA allowed public dialogue to influence its recommendation, mentioning that from a scientific point of view, there were no indications that sex selection is harmful (Wooding et al. 2005). This evaluation is pointing to one of the most serious arguments which can be brought in against public participation in technology related decision-making: the issues at stake are often very complex and thus not in each detail understandable by the general public. The decisions reflect thus a certain state of intuitive risk perception (Slovic). In the worst case, they lead to a *type I error* or "false positive" which means potentially refusing a promising technology because its safety cannot be proven. However, the public may also decide according to a feeling that the respective technology is not welcomed, no matter how harmless it is. One has to acknowledge that the general public applies a different mode of decision making with respect to new technologies than the directly involved experts and other stakeholders.

**Public involvement as a key in RF-EMF health risk evaluation**

Besides legitimating democratic political decision-making, public participation is often realized when certain developments are charged by social conflicts and a diversity of

[3] PGD is not explicitly forbidden in Germany. But it is not applied because of incompatibilities with the current Embryo Protection Act (Kress 2007).

[4] An overlook can be found at: http://www.hfea.gov.uk/en/1511.html#Published_responses

[5] See: http://www.hfea.gov.uk/docs/Final_sex_selection_summary.pdf

conflicting interests. One of those topics is the question whether mobile telephony can cause cancer. With the worldwide dramatic increase in the use of mobile phone technology in the early 1990s, concerns were voiced whether radio frequency electromagnetic fields (RF-EMF) submitted by mobile telephony may cause brain cancer in humans.

The potential of RF-EMF to cause cancer is a hotly debated issue. One of the major actors influencing public perceptions of potential health risks of EMF is the media. A German media coverage analysis (Grummich et al., 2007) has recently revealed that German print media do not draw a uniform picture of the state of research, regarding RF-EMF cancer risks. It was shown that both the emergence and the nature of the media coverage in the newspapers investigated do not reflect the scientific state of the art on mobile phone use relating to possible health effects. Instead of informing the public close to the scientific facts, and thereby taking over a responsible role in a process of risk communication, some media process information in a way which is misleading and might increase emotionally based uncertainties in the population regarding radio-frequent electromagnetic fields.

Alongside with the societal controversy whether mobile telephony induces adverse health effects (including cancers), there is still a *scientific uncertainty* whether there is a relation between mobile telephony and cancer. On the one hand, the majority of scientific studies published so far do not provide convincing evidence that mobile phone use increases the risk of brain tumours or acoustic neuroma (SSK 2006; SCENIHR 2007). On the other hand, there have been few studies showing hints for adverse effects (e.g. Repacholi et al. 1997; more recently: Lahkola et al. 2007). Thus, as the diffusion of mobile phones in the society becomes increasingly common, there are still knowledge gaps in assessing health risks of RF-EMF on humans (SCENIHR 2007, 28).

It was argued that uncertainties are a necessary by-product of scientific certainty and that with ever increasing knowledge one can never exclude scientific and/or moral uncertainties (Tannert et al. 2007). Notwithstanding, the public perception of mobile phones is strongly dependent on the scientific one. It is thus not astonishing, that there are fears and concerns in the public, related to health risks of RF-EMF. According to a recently finished survey for the German Federal Office for Radiation Protection (SSK), 18% of the German population have “strong” or “quite strong” concerns with regard to possible health effects of use of mobile phones, and 28% pretend to be at least “a little concerned”. Thus, more than half of the German population is concerned. Moreover, only 20% of the public feel “very well” and “well” informed about EMF, whereas 27% feel “not informed at all”. The majority, 53%, feels “a little” informed[6]. Hence, there is both a considerable amount of people who don’t feel safe with respect to the use of mobile telephony, and a high proportion of people who feel uninformed or not well informed, respectively. And, this picture has not changed fundamentally throughout the last years.

Is it, against this background, necessary to either improve or increase measures of precaution with respect to mobile telephony? With regard to public fears against adverse effects of mobile telephony, is it thus wisely to ban the use of cell phones for children, since one of the issues with the highest degree of scientific uncertainty is the question of

[6] The study was presented on a workshop of the German Mobile Telecommunication Research Programme (DMF) in October 2006: http://www.emf-forschungsprogramm.de/abschlussphase/KP_intFG_Risiko.html

possible adverse effects on developing tissues and organs? Perhaps not, since it was shown that precautionary measures which are based on actual risk perceptions seem to be regarded as indications for a true risk, and actually do *decrease* trust in public health protection instead of increasing it (Wiedemann and Schütz 2005). Public Health authorities therefore stress the importance of communicative approaches to tackle the various risk perceptions of both individuals and corporate actors, as e.g. local authorities (who are concerned with decisions about the siting of RF EMF base stations). The WHO points out that "potential risks of EMF exposure […] present a difficult set of challenges for decision makers. The challenges include […] risk assessment; […] risk perception; and […] risk management. Responding to these challenges requires the involvement of individuals or organizations with the right set of competencies, combining relevant scientific expertise, strong communication skills and good judgement in the management and regulatory areas."(WHO 2002, vii).

Altogether, in order to reveal the individual risk perception related to the widespread, ubiquitous application of mobile telephony in the public, and in order to account for the fact that the evaluation of risks is to a large extent a societal and political problem, rather than a scientific one (Jungermann and Slovic 1993, 98), public participation is a fundamental tool to both translate scientific risk calculations into the perceptibility of humans and to communicate on still existing knowledge gaps. Below we well introduce an approach, how public participation could be implemented in the scope of a research project, which is intended to answer the question whether genomics can contribute to the RF-EMF health risk research.

**The IMBA stakeholder discourse online**

There is no rule that public consultations must address the lay people, necessarily. As was shown in the examples from the U.K., also experts may be involved. Moreover, representatives from several interest groups, authorities and organizations can be asked to participate in the risk management process. The choice of the consulted actors depends much on the purpose of the consultation.

Subsequently we will outline the approach of public consultation within the scope of the IMBA (Implications of Biomedicine for the Assessment of Human Health Risks) project. IMBA is health technology assessments project which analyses how new developments in biomedicine, which are often summarized under the term "toxicogenomics", will transform the present risk management framework. One of IMBA's key issues is to reveal both promises and uncertainties of toxicogenomics, regarding potential health effects of RF-EMF. Therefore – additionally to scientific experts – we address *stakeholders*, concerned with mobile phone technology, as regards use and regulation (e.g. industry, authorities) and public information and empowerment (e.g. medical organizations, NGOs).

We regard stakeholders an important group in decision-making. Their assessment of uncertainties and perception of promises of toxicogenomics to address knowledge gaps in RF-EMF cancer risk research is essential for a successful risk communication with all involved persons and institutions. The participation of various stakeholders further corresponds to the social and political aspects of risk evaluation and allows for the consideration of health protection issues as well as of societal benefits related to the development and application of mobile phone technology.

Therefore, we invite stakeholders from the following fields of action, to contribute to the stakeholder discourse:

- Industry and commerce
- Public authorities
- Medical organizations
- Mobile phone critics and self-help groups
- Scientific institutions
- NGOs

As already mentioned scientific uncertainties are still perceived important barriers to mention the harmlessness of mobile telecommunication. The IMBA stakeholder discourse is intended to mainly answer the question, which knowledge gaps are assessed as most crucial, by the stakeholders. These knowledge gaps need not to refer to scientific ones solely, but can also include gaps in the communication of scientific knowledge to the public.

The IMBA stakeholder discourse is implemented online. There will be a web based discussion forum, with moderated discussions in several threads. Instead of coming together to meetings several times, the Internet enables round-the-clock discussions. Any opinion can be given as soon as the involved stakeholder has one. There is no difference in taking part between stakeholders with strong material resources and those with weaker ones. The experiences with the internet as a means for deliberate technology evaluation made so far support our hope that online based risk communication can be successful, if special attention is given to certain structural conditions (cf. Niewöhner and Tannert 2004): Which are the motives to participate? How can a lively discussion be guaranteed? What kind of input does the moderator/facilitator have to provide?

Among the criticism against internet-based procedures to health education and risk communication is the argument that especially people from the lower educational groups have higher barriers of access and use it less as a communication medium, than the better educated ones. With respect to the stakeholder discourse this aspect is negligible, since the stakeholders are contacted via e-mail, which guarantees that they have access to the Internet. However, for future discourses on the issue of societal and health implications of mobile phone technology which are intended to also include lay persons from all societal levels, this point has to be carefully considered.

**Conclusions**

Participative procedures to risk communication and technology evaluation are defined as a combination of instruments and methods aiming at an involvement of lay persons and/or stakeholders in the process of the evaluation of technologies (Abels and Bora 2004, 13). It is important to stress that participative procedures are not intended to only contribute to the public's needs, but to assist experts and politicians in defining fields of research and sketching options for decision-making.

To include the public in the process of risk management is a means to encounter its experiences and concerns related to new technologies that are supposed to unfold impacts on human well-being and health. Furthermore, increasingly it is regarded as of high relevance to include the everyday experiences and – even more – the moral

convictions, of the general public and its diverse subcultures within a plural society, into the complex process of risk management. This is contributing to the fact that in an age of technologies, seriously challenging the self conception of humankind and bearing incalculable risks to whole societies, risk evaluation is to a large extent a social and political issue, besides the scientific approaches to characterize and analyse technological risks to human existence.

Our approach towards stakeholder participation with an online-based discussion forum is referring to a research field, which is characterized by an inconsistency between major scientific knowledge and public perceptions. On the one hand, there is a bulk of investigations on the risks associated with the use of mobile phones, suggesting that there seems to be no reason to fear fatal damages to human health by the radiation of the mobile appliances. On the other hand there is an ongoing controversy between scientific camps, which is based on certain knowledge gaps identified in present studies on the question whether RF-EMF can cause genetic defects, and cancers.

Stakeholders are regarded primarily as advocates of their own interests. But, all of them, including the industry and the commerce, can be regarded as transmitters between science, politics, and the general public, as well. Of course, interest groups can promote biased perceptions by making claims and refusing to both communicate and adjust with reality. Our media coverage analysis (Grummich et al. 2007) has provided hints that some media play such a role, thereby counteracting attempts to objective communications on pros and cons of mobile phone technology. However, stakeholders can also be important actors in a process of mitigating and buffering societal conflict. To include their own perceptions and allowing for a discussion on knowledge gaps of RF-EMF health risk research between different stakeholder groups could contribute to strengthen a communication process on both the benefits and risks of a technology and thus enhance trust in the risk management framework.

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