

# **An empirical analysis of communication flow, strategy and stakeholders' participation in the risk communication literature 1988–2000**

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## **Abstract**

**Risk communication during the years has shown its vitality and has proved its importance as a field of research. This article provides a brief record of the development of risk communication in the environmental and technological domain by examining some of the trends resulting from the analysis of the theoretical and empirical literature in the field, as it is available through scientific journals. In total, 349 peer-reviewed articles published between 1988 and 2000 and listed in the ISI Web of Science databases were analyzed. The theoretical perspective that we use is that of control mutuality, which emphasizes the interaction between the parties in the risk decision-making process and their mutual influence, rather than simply unidirectional control of one stakeholder over the other. It echoes the democratic perspective, but also considers the rationality of the technical standpoint.**

**The results indicate that over the whole period there is an increase in published articles on risk communication. As expected, we found a gradual decrease in the articles referring to a one-way flow of risk communication and an increase of those concerned with two-way communication. We also observed a gradual increase in the articles referring to stakeholder participation in risk decisions in the last period. No differences were found with respect to risk communication strategy.**

**KEY WORDS:** risk, risk communication, development, empirical content analysis, control mutuality

## **1. Introduction**

Risk communication on environmental, industrial and technological risks, as every other field of science, is characterized by introduction, extension, the challenge of ideas, theories, approaches and practices. The research on different aspects of risk communication is

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growing every day, demonstrating the dynamic character of the discipline (Gurabardhi *et al.*, 2004). The idea of employing communication tools in an attempt to cope with different hazards or risk contexts is not very new. In fact, it has been around for a considerable time in the domain of health risks as well as that of environmental issues. However, the term “risk communication” first appeared in the literature in 1984 (Leiss, 1996).

The efforts to describe the development of risk communication and to point out some of its changing characteristics are mostly narrative (see Fischhoff, 1995; Leiss, 1996; Chess, 2001; Covello and Sandman, 2001). The variety of perspectives and paradigms, with their origins in cognitive and social psychology, communication science, political science, the organizational field, and natural and life sciences, has made risk communication a truly multidisciplinary field of science (Gurabardhi *et al.*, 2004). Any attempt to characterize the domain of risk communication has to cope with this inherent complexity.

Researchers as Fischhoff (1995), Leiss (1996), Chess (2001) and Covello and Sandman (2001) have identified some common criteria and principles of the theoretical and empirical studies on risk communication. They emphasized the strategies of communication in terms of information transfer, persuasion or dialog (Fischhoff, 1995; Juanillo and Scherer, 1995; Leiss, 1996) and the communication flow with one-way or two-way flows of information (Beierle, 1998; Sandman, 1994). They also mention the risk decision-making process and underline the importance of empowering different stakeholders to contribute to risk decisions (Rich *et al.*, 1995). Empowering different stakeholders is seen as a way to building and maintaining trust (Heath and Palenchar, 2000).

The description of developmental changes in risk communication is considered by its own authors as “speculative” (Fischhoff, 1995), because it is not based on quantitative analysis. To our knowledge, there are no quantitative studies yet which investigate the evolution of risk communication literature based on the communication strategy, communication flow or decision-making characteristics. Taking the quantitative perspective as a starting-point, Gurabardhi *et al.* (2004) presented a bibliographical analysis of developments in the scientific risk communication literature between 1988 and 2000. They point out that the risk communication literature is dominated by a few very productive scientists, who have published many papers and are cited frequently by other scientists (which they consider to be a criterion for relatively influential papers and authors). All of the most productive authors are from the USA or Western Europe.

The aim of the present study is to apply a quantitative analysis to the content of the risk communication literature with respect to communication strategy, communication flow and decision-making characteristics.

## **2. Risk communication development**

The debate with respect to risk communication strategy, flow and stakeholder participation in risk decision-making resulted in the identification of two very different perspectives on risk communication and risk management, the so-called technical and democratic perspectives (see, e.g., Rowan, 1994). Several researchers have explored this distinction (see Fiorino, 1990; Juanillo and Scherer, 1995; Renn *et al.*, 1995; Rowe and Frewer, 2000).

The technical standpoint claims that decisions regarding technical issues should be left in the hands of experts and scientists with relevant knowledge. The proponents of this view express their concern that involving the public can result in technically incompetent

decisions (see Rowe and Frewer, 2000; Löfstedt, 2004) and that it is also inefficient from an economical point of view. The technical perspective stresses the values of rationality, efficiency and expertise, based in quantitative data handled by technicians. Communication is simply seen as an information and education process, focusing on the transmission of information from governmental or private organizations to the public, on persuading people to accept expert risk judgments, or calming down the public's concerns.

The democratic view focuses on issues such as justice and fairness, and claims that citizens should be able to co-determine the decisions that affect their livelihood (Fiorino, 1990; Renn *et al.*, 1995). This perspective considers risk communication as a constructive dialog among all stakeholders—government, industry, shareholders, NGOs, community leaders and general public—and the risk decision as an outcome of this dialog. The democratic perspective stresses subjective, experiential, social and cultural values and underlines the need to involve different stakeholders in risk management and decision-making.

In this article, we will further explore the concept of *control mutuality* which is concerned with the concept of power equity or reciprocity, the empowerment of community people and the organizations' commitment to deal with the public as a partner. Control mutuality is defined as the "degree to which parties agree who has the rightful power to influence one another" (Grunig and Hon, 1999). The concept emphasizes the interaction between the parties in the risk decision-making process and their mutual influence rather than simply unidirectional control of one stakeholder over the other. The concept of control mutuality echoes the democratic perspective, but also considers the rationality of the technical standpoint. The construct combines perspectives of different disciplines' on risk. It refers to the organizational perspective, which emphasises the need to consider all stakeholders when making risk decisions. Control mutuality also relates to the discourse model, which sees communication processes as characterized by a two-way communication flow, as a dialog, based on introduction of different goals, opinions and arguments.

### 3. Research questions

For our analysis on control mutuality, we will look at the risk communication strategy, the flow of risk communication as one-way or two-way, and at stakeholder participation in risk decision-making processes, as they are evidently important indicators of control mutuality. Our main research question is *whether control mutuality is getting more attention in the scientific risk communication literature on environmental, industrial and technological risks over the years*. To answer this question, we identify the following sub-questions:

- Is there a change in the risk communication research literature from a one-way communication flow to two-way communication?
- Is there a change in the risk communication research literature reflecting an increase of dialogic communication strategies over the years compared to informative or persuasive strategies?)
- Is there a change over the years in the level of stakeholder participation in risk decision-making processes as described in the risk communication research literature?

We expect that over the years more articles are published which echo control mutuality, that means more articles dealing with the dialog characteristics than information and persuasion; more literature emphasizing two-way than one-way communication forms and more articles underlining public input on risk decisions by expanding and combining decisions' arguments.

Considering the previous findings of Gurabardhi *et al.* (2004), we will also study the role of authorship and the country of origin (USA/Canada vs. Western Europe) of the authors related to issues of risk communication strategy, flow and stakeholder participation.

## 4. Method

### 4.1. SELECTION PROCEDURE

To gather references to published peer-reviewed scientific articles on risk communication, we used the electronic databases ISI Social Sciences Citation Index, ISI Science Citation Index and the ISI Arts and Humanities Citation Index (all Web of Science). According to the publisher of these databases, the Social Sciences database covers over 1,700 of the world's leading scholarly social science journals, covering more than 50 disciplines (<http://www.isinet.com/>). In the Science database, references can be found of 5,900 of the world's leading scholarly science and technical journals, covering more than 150 disciplines. Finally, the Arts and Humanities database covers 1,130 of the world's leading arts and humanities journals. The three databases partly overlap. For the period of our study, these databases contain over 13 million peer-reviewed journal articles. The journals incorporated in these databases are selected for having peer-review systems which are designed for improving the quality of the published papers. The ISI databases provide a wealth of descriptive characteristics for each article, including the title, authors, full abstract, keywords, and bibliographical data.

In this article, we will describe the development of peer-reviewed risk communication literature in the domain of environmental, industrial and technological risks. This domain comprises all risks to which people are exposed either individually or in groups, that are man-made (they have an industrial or technological origin), and which have consequences for safety, health or the environment. This is also the domain that would best describe the previous work of authors like Fischhoff, Leiss, Chess and others. Our sample consists of all relevant journal articles published between 1988 (the first year of electronic publication of the Web of Science) and 2000 listed in these online databases. The sample does not include book reviews, editorials, conference proceedings, dissertations, books, and book chapters. The data were collected in August 2001 and coded afterwards, and analyzed with SPSS.

All databases were searched with a search key, which was developed by an independent information specialist working at our university, after being briefed about the goal of our project. The search key was: Topic=(risk communication or ((risk\* or hazard\*) and (communicati\* or warn\*))) and ((environment\* or industr\* or technolog\*) or (participation or public involvement)). Searches were performed in article keywords, article title and article abstract. All search results (the raw data) were printed (Science Citation Index n=811; Social Sciences Citation Index n=512; Arts & Humanities n=14). We removed articles that were double or triple references (that were available in more than one database), were not journal articles (but book reviews, editorials, etc.), or were not related

to risk communication about environmental, industrial and technological issues as stated in our definition of the domain. The researchers discussed each decision in this selection process. The topic of most of the articles that were removed, did not relate to environmental, industrial and technological issues as stated in our definition. The final number of articles is 349 (upon an e-mail request to the authors, a list of all 349 articles is available to readers of *Journal of Risk Research*).

#### 4.2. CODING

For each case in our sample we coded descriptive variables, available on the ISI database printouts, and interpretative variables that required a coder's judgment. In this article, we report on three interpretative variables and four descriptive variables. As interpretative variables, the components of control mutuality were coded: risk communication flow, risk communication strategy, and stakeholder participation in risk decision-making. "Risk communication flow" refers to the one-way flow of communication (top-down or bottom-up), and two-way flows. We coded articles referring to advisory committees, consensus conferences, and negotiation as representing a two-way flow. "Risk communication strategy" refers to technical information (data-sheets, information based on quantitative risk assessment, and comparative risk estimates), or persuasion (marketing approach, message clarity, audience perception of risk issues, and risk education) or dialog (characteristics of discourse). The variable "Stakeholders participation in risk decision making" relates to stakeholders (government, industry, shareholders, NGOs, community leaders and general public) input in risk decision-making processes and is strongly related to organizations' commitment. The stakeholders input in risk decision making process is assessed by coding whether the articles describe that the stakeholders' opinions and values are incorporated in risk decision or not. No specification is made whether the risk decision is result of organizational commitment, or empowerment, or a result of the of external environment pressure on organizations.

Two independent observers coded the interpretative variables. The agreement among the coders was calculated after recoding a random sample of 93 articles from the total sample of 349 articles and it was found to be 86%, 67%, and 75% (for risk communication flow, strategy, and stakeholder participation, respectively). This level of agreement is satisfactory. The researchers discussed inconsistencies in coding per article, after which a final code was attributed.

As descriptive variables we used authors' names, year of publication, authorship (the names of all authors were listed) and country of the first author. For these variables no intercoder reliability was calculated, because the data came directly from the ISI database, and did not involve a coder interpretation. For the variable authorship, we made a distinction between most productive authors (with four or more published articles), important authors (with two or three articles in the sample) and incidental authors (with one article in the sample). The country of origin of the first author was derived from the author's affiliation, which is also listed in the ISI database. (We coded the affiliation of the first author, i.e., the address of the organization which employs the first author. It should be noted here that the variable "country" refers to the country in which the institute resides, which employs the author, and not so much the country of origin of the author.) Gurabardhi *et al.* (2004) present additional information on other aspects that were analysed.

### 4.3. TIME PHASING

As we mentioned above, we collected the articles published during the years 1988 through 2000. We divided these years in three periods. The first period (1988–1992) is characterized by a rather slow start. In this period 13% of the articles in our sample were published. The second period (1993–1996) is characterized by a rather strong increase in number of articles. We found that 39% of all articles in our sample were published in the second period. The third period is the four-year period 1997–2000, which seems best described as the phase of consolidation where the number of publications remains at a more or less stable rate. In this period, 48% of all articles in our sample were published. Over the whole period, we observed an increase in published articles on risk communication (see Table 1). Because of these differences in periods, in the following analyses we will report in percentages rather than numbers.

## 5. Results

In this section we present the results from our analyses on changes in the literature on risk communication flow, risk communication strategy and stakeholder participation in the risk decision-making process over the years. For each of these analyses, we also looked at the role of authorship and country of origin of the author.

**Table 1.** Nine most relevant journals for risk communication (with five or more publications between 1988–2000).

| Journal (ISSN)  | Number of<br>articles in sample | Period |       |       |
|---|---------------------------------|--------|-------|-------|
|   |                                 | 88–92  | 93–96 | 97–00 |
| <i>Risk Analysis</i> (0272-4332)                              | 42                              | 6      | 24    | 12    |
| <i>American J. of Industrial<br/>Medicine</i> (0271-3586)     | 15                              | 1      | 13    | 1     |
| <i>J. of Hazardous Materials</i><br>(0304-3894)               | 12                              | 1      | 3     | 8     |
| <i>Radiation Protection<br/>Dosimetry</i> (0144-8420)         | 8                               | 2      | 5     | 1     |
| <i>Health Physics</i> (0017-9078)                             | 7                               | 0      | 2     | 5     |
| <i>J. of Occupational and Env.<br/>Medicine</i> (1076-2752)   | 6                               | 0      | 3     | 3     |
| <i>Environmental Health<br/>Perspectives</i> (0091-6765)      | 5                               | 1      | 3     | 1     |
| <i>Human and Ecol. Risk<br/>Assessment</i> (1080-7039)        | 5                               | 0      | 0     | 5     |
| <i>Environmental Science<br/>&amp; Technology</i> (0013-936x) | 4                               | 0      | 0     | 4     |
| Total nine journals   | 104                             | 11     | 53    | 40    |
| Total sample  | 349                             | 46     | 136   | 167   |
|   | 30%                             | 24%    | 39%   | 24%   |

5.1. RISK COMMUNICATION FLOW OVER THE YEARS

Figure 1 presents the articles related to risk communication flow and their distribution over the three periods. Of the total of 349 cases, 281 articles are coded as two-way or one-way communication. The articles dealing with or referring to two-way communication constitute 44% of these 281 cases (see also Table 2). Concerning the distribution of the articles over the periods, the two-way articles form 30% of the articles of the first period, 39% of the second period and 51% of the third. Consequently, the articles with a focus on one-way communication constitute 70% of the articles of the first period, 61% of the second and 49% of the third. As expected, the statistical analysis indicates that the difference of risk communication flow in the periods is significant, emphasising a gradual decrease in the proportion of articles referring to an one-way flow of risk communication and an increase in those concerned with two-way communication ( $\chi^2=6.22$ ,  $df=2$ ,  $p=0.045$ ). As Fig.1 indicates, the absolute number of one-way and two-way articles increases, although it should be noted that the increase of one-way articles from period two to period three is only marginal.

5.2. RISK COMMUNICATION STRATEGY OVER THE YEARS

To study whether changes have occurred over the course of the years in the literature on risk communication strategy, the articles in the sample were coded according to three categories: informative, persuasive and dialogic (see Fig. 1). The analysis shows a higher number of articles related to persuasion (44%), compared to articles about technical information, which constitute 26% of the articles coded. Of the articles, 30% was referring to dialog. Regarding the changes of the risk communication strategy over the periods, the

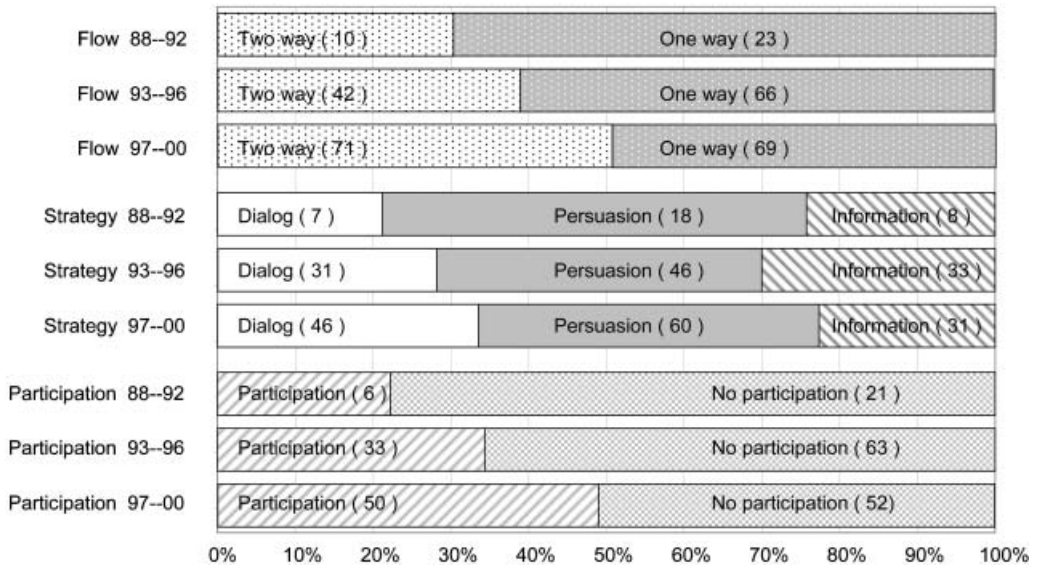


Fig. 1. Risk communication flow, risk communication strategy and stakeholder participation by period, in percentages, with absolute number of articles in parenthesis (sample: n=349 articles).

**Table 2.** Breakdown of risk communication flow, strategy and stakeholder participation by authorship.

|                                    | <i>Authorship</i>            |  |  | <i>Total</i> |
|------------------------------------|------------------------------|--|--|--------------|
|                                    | <i>One article in sample</i> | <i>Two or three articles in sample</i> | <i>Four or more articles in sample</i> |              |
| <i>Risk communication flow</i>     |                              |  |  |              |
| Two-way                            | 43%                          | 31%                                    | 61%                                    | 44%          |
| One-way                            | 57%                          | 69%                                    | 39%                                    | 56%          |
| <i>Risk communication strategy</i> |                              |  |  |              |
| Technical information              | 29%                          | 16%                                    | 21%                                    | 26%          |
| Persuasion                         | 42%                          | 62%                                    | 36%                                    | 44%          |
| Dialog                             | 29%                          | 22%                                    | 43%                                    | 30%          |
| <i>Stakeholder participation</i>   |                              |  |  |              |
| No participation                   | 63%                          | 68%                                    | 40%                                    | 60%          |
| Participation                      | 37%                          | 32%                                    | 60%                                    | 40%          |

statistical analysis indicated that the difference between the periods was not significant ( $\chi^2=3.82$ ,  $df=4$ ,  $p=0.43$ ).

### 5.3. STAKEHOLDERS PARTICIPATION IN RISK DECISION MAKING OVER THE YEARS

The stakeholders input in risk decision making process is assessed by coding whether the articles describe that the stakeholders' opinions and values are incorporated in risk decision or not. No specification is made whether the risk decision is result of organizational commitment, or empowerment, or a result of the of external environment pressure on organizations.

The data show that the articles referring to a lack of stakeholder participation form 60% of the total number of the articles reflecting stakeholders' involvement or not in risk decisions. When looking at the distribution according to the periods, a significant difference is evident ( $\chi^2=8.29$ ,  $df=1$ ,  $p=0.02$ ), which emphasizes a gradual increase in the articles referring to stakeholders input in risk decisions, from 22% in the first period to 48% in the last period. The results are presented in Fig. 1.

### 5.4. AUTHORSHIP AND FLOW, STRATEGY AND PARTICIPATION

The results of the analysis of the relation between risk communication flow and authorship are presented in Table 2. The data indicate that 61% of the articles written by the most productive authors are dealing with issues related to two-way communication, while the articles written by important or incidental authors are mostly concerned with the one-way flow of communication (69%, and 57%, respectively;  $\chi^2=7.85$ ,  $df=2$ ,  $p=0.02$ ).

Table 2 also shows the breakdown of risk communication strategy according to the three types of authorship. The data indicate a significant difference related to the authorship of the articles ( $\chi^2=10.41$ ,  $df=4$ ,  $p=0.03$ ). Articles written by the most productive authors focused more on dialogic content (43%), and less on persuasion (36%)



and technical information (21%). The articles written by the important authors contribute mostly to persuasive content (62%) and less to dialogic content (22%) and technical information (16%). The articles written by incidental authors present a similar picture as the authors with two or three articles in the sample.

The data referring to the relationship between authorship and stakeholder participation in risk decision-making processes are also presented in Table 2. The data indicate a significant difference between the most productive authors and the others ( $\chi^2=7.60$ ,  $df=1$ ,  $p=0.02$ ). Of the articles by the most productive authors 60% reflect participation processes of risk stakeholders. In contrast, most of the articles by incidental (63%) or important (68%) authors describe risk communication processes without stakeholders being involved in risk decision-making.

### 5.5. COUNTRY OF ORIGIN AND FLOW, STRATEGY AND PARTICIPATION

We were also interested in the distribution of researchers from Western Europe and America/Canada. Statistical analysis showed no significant relation between country of origin of the first author and the description of risk communication flow in the articles in the sample.

The analysis of the relationship between the risk communication strategy and country of origin of the first author showed a significant difference between the researchers of these two continents ( $\chi^2=6.39$ ,  $df=2$ ,  $p=0.04$ ) (see Table 3). The data indicate that almost 50% of the articles by authors from USA/Canada are focused on persuasion, which is almost as much as for both other types together (28% and 25% on technical information and dialogic, respectively). For Western European authors the differences between risk communication strategies are less profound, although articles on dialogic risk communication seem to outnumber both persuasion and technical information.

The analysis of the relation between stakeholder participation in the risk decision-making process and the country or the author's origin is also presented in Table 3. There is a significant difference between these groups of risk communication researchers ( $\chi^2=4.09$ ,  $df=1$ ,  $p=0.04$ ). Of the articles by American/Canadian authors, 35% describes risk communication processes in which stakeholder participation plays a role in the risk decision-making. Of the articles by Western European authors, 51% describes that type of processes.

**Table 3.** Breakdown of risk communication strategy and stakeholder participation by authors from USA/Canada and Western Europe.

|                                    | <i>Country of first author</i> |                       |              |
|------------------------------------|--------------------------------|-----------------------|--------------|
|                                    | <i>USA/Canada</i>              | <i>Western Europe</i> | <i>Total</i> |
| <i>Risk communication strategy</i> |                                |                       |              |
| Technical information              | 28%                            | 26%                   | 27%          |
| Persuasion                         | 47%                            | 34%                   | 43%          |
| Dialog                             | 25%                            | 41%                   | 30%          |
| <i>Stakeholder participation</i>   |                                |                       |              |
| No participation                   | 65%                            | 49%                   | 61%          |
| Participation                      | 35%                            | 51%                   | 40%          |

### 5.6. INTERRELATIONS BETWEEN RISK COMMUNICATION STRATEGY, FLOW AND STAKEHOLDER PARTICIPATION IN RISK DECISION-MAKING

In our analyses we described three identifiers of the concept of control mutuality (risk communication strategy, flow and stakeholder participation in the risk decision making processes) as well as the results for each identifier separately. However, the question is how these three aspects are interrelated. We found an interrelationship between flow and strategy and between flow and stakeholder participation, in the sense that two-sided communication was more likely in combination with dialogic strategies of communication, and more stakeholder input in decision-making (see Table 4). And we found that one-way communication flow related to informative and persuasive strategies and no stakeholder participation in risk decision-making. Furthermore, we found that dialogic strategies were more likely when stakeholders participated in the risk decision-making process, and that informative and persuasive strategies were more likely when stakeholder participation is lacking. We cross-tabulated the variables and found that explained variances were rather high (see Table 4).

## 6. Conclusion and discussion

The central objective of this study was to point out the development of thinking in risk communication literature based on a quantitative analysis of that literature. Before we start elaborating on some of the intriguing results of our study, it is good to say something on the study's scope and limitations, to place the results in the proper perspective. A first caveat is that we set out to study risk communication primarily in the technological, industrial and environmental domain, based on the assumption that these issues are studied from the early 1980s until the present day. This implies that developments in risk communication in other fields are left out of this study; we did not look at such issues as cyber risks, health risk communication, terrorism, etc. A second caveat is that we only focused on the material that is incorporated in the Web of Science-databases. One may say that a study like this is as good as the database used or as good as the keywords assigned to an article by its author or publisher. Based on the large amount of peer-reviewed journals that are listed in the Web of Science databases, we are convinced that our sample

**Table 4.** Interrelation and explained variance between three identifiers of control mutuality in articles on risk communication 1988–2000.

|   | <i>Stakeholder Participation<br/>(yes, no)</i>  | <i>Risk communication strategy<br/>(Informative, persuasive, dialog)</i> |
|---|---|--|
| Risk communication flow<br>(one-way vs. two- way)                   | $\chi^2=122.85$ , $df=1$ , $p<0.00005$<br>Eta .75 (both dependent)                        | $\chi^2=119.36$ , $df=2$ , $p<0.0005$<br>Eta .67 (flow dependent).       |
| Risk communication<br>strategy (Informative,<br>persuasive, dialog) | $\chi^2=97.83$ , $df=2$ , $p<0.0005$<br>Eta .69 (stakeholder<br>participation dependent). |  |

Note:  $\chi^2$  is used as indicator of interrelation. Eta is an indicator of explained variance. In the analyses involving the 3 categorical factor risk communication strategy, the dichotomous variable (flow, stakeholder participation) is treated at the dependent variable.

provides an adequate representation of risk communication developments from 1988 to 2000 as published in peer-reviewed journals. Although in these databases many thousands of peer-reviewed journals are listed, it is possible that one or two journals relevant to risk communication are not part of our sample. We are aware of the fact that the *Journal of Risk Research* was not listed in Web of Science when we gathered the data for this study. However, this is a relatively new journal that is published since 1998, so we missed only three volumes (1998–2000) with a handful of articles relevant to our study. (It is important to stress here that this exclusion of the *Journal of Risk Research* is not based on the choice of the researchers, but on the fact that the publisher or editor of the journal or the ISI organization decided not to incorporate it in one of the databases. The three volumes of the *Journal of Risk Research* (1998–2000) contained 99 entries, including 83 articles. Of those 83 articles, nine would have fitted in our search key. Seven articles were contributed by European authors and two by US authors. Seven of the most productive authors and 4 in the list with two or three publications also produced these nine articles. Starting 2004, the *Journal of Risk Research* is incorporated in the ISI databases.) In future studies we may want to incorporate other databases as well, and perhaps broaden the scope to other types of scientific publications, such as peer-reviewed conference proceedings, dissertations, etc.

As a key construct to look at that development we used control mutuality, which was seen as comprising three main components: a two-way communication flow, dialogic strategy and stakeholders' input in risk decision-making. These components have been also used by previous narrative studies concerning the development of risk communication as criteria for risk communication characterization. We started out to answer the question whether control mutuality was getting more attention in the peer-reviewed literature on risk communication on environmental, industrial and technological risks over the years. In a general sense, our study shows that control mutuality is getting more attention. This is in line with the narrative analyses by Fischhoff (1995) and Leiss (1996). Our results are different, however, to those studies with the finding that more interest in control mutuality in the peer-reviewed risk communication literature does not mean that the interest of researchers for persuasion or technical information decreases. Over the years, the interest for these risk communication strategies remains rather constant.

An expectation of the study was an increase of the articles representing the two-way communication flow in the last period, referring to a more large-scale use of forms such as Community Advisory Panels, Citizen Juries, negotiation, etc. The results of the analysis meet that expectation. The data showed an increase of the articles representing two-way communication flow of 30% in the first period to an amount of 51% in the last period, and a decrease of the articles representing one-way communication flow to 49% of the cases, compared to 70% of the cases during the first period. Again, as in the case of risk communication strategies, the most productive authors were dealing more with two-way risk communication flow. There was no significant difference between articles from the USA/Canada and Western Europe concerning the communication flow.

The second characteristic observed with regard to our research questions was continuity in the use of the different communication strategies during the studied period. Overall, there is no sign of a significant change from persuasion or the provision of technical information to more dialogical communication. Persuasion showed its energy despite an increase in the dialogic strategies. The incidental and important authors seemed to have a role in this fact, since most of them were dealing with issues related to persuasion

(respectively 42% and 62%). The most productive authors were focused mostly in the dialogic strategies (43%). From the analysis, it became evident that persuasion was more in focus in articles of USA/Canada authors, than in articles from Western European authors. An important question is whether differences in the scientific literature from both hemispheres are a reflection of the risk communication practices on both sides of the Atlantic.

The stakeholders' input in risk decisions constitutes an important indicator of the development of thinking in risk communication. It refers to a responsible risk communication, to organizations' commitment as well as community and other stakeholders' empowerment. It was expected that during the last period the weight of this component in the literature of risk communication would be higher than in the previous periods. The results met the expectation. They indicated a gradual increase of the articles referring to stakeholders input in decision-making in the last period, and a decrease of those related to no stakeholders' input. Of the articles of most productive authors, 60% were concerned with issues related to stakeholders' input in decision-making while the rest of the authors, incidental and important, mostly were not emphasizing the stakeholders' input in their articles (approximately 65%). A significant difference was noticed in the relationship between this issue and the USA/Canada and Western European authors, with Western European authors most focused on stakeholders' role in risk decision-making.

Turning back to control mutuality construct, it can be concluded that it is having more weight in the literature of risk communication. Interesting to emphasise in this development are the data showing the most productive authors and the Western European authors as more focused on issues of two-way communication, dialog and stakeholders' input in risk decision-making.

## References

- Beierle, T. (1998) Public participation in environmental decisions: using social goals, in *Resources for the Future*, [http://www.rff.org/about\\_rff/web\\_bios/beierle.htm](http://www.rff.org/about_rff/web_bios/beierle.htm)
- Chess, C. (2001) Organisational theory and the stages of risk communication, *Risk Analysis* **21** (1), 179–88.
- Covello, V. and Sandman, P. (2001) Risk communication: Evolution and revolution, in A. Wolbarst (ed.) *Solution to an Environment in Peril*, pp. 164–78. Baltimore, MD: John Hopkins University Press.
- Fiorino, D. (1990) Citizen participation and environmental risk: a survey of institutional mechanisms, *Science Technology and Human Values* **15** (2), 226–43.
- Fischhoff, B. (1995) Risk perception and communication unplugged: Twenty years of process, *Risk Analysis* **15** (2), 137–45.
- Grunig, J. E. and Hon, L. C. (1999) *Guidelines for Measuring Relationships in Public Relations*, University of Florida: The Institute for Public Relations Commission on PR Measurement and Evaluation.
- Gurabardhi, A., Gutteling, J. M. and Kuttschreuter, M. (2004) The development of Risk Communication: An empirical analysis of the literature in the field, *Science Communication* **25** (4), 323–49.
- Heath, R. and Palenchar, M. (2000) Community relations and risk communication: A longitudinal study of the impact of emergency response messages, *Journal of Public Relations Research* **12** (2), 131–61.

- Juanillo, N. K. J. and Scherer, C. W. (1995) Attaining a state of information judgments: Toward a dialectical discourse of risk, in B. B. Burelson (ed.) *Communication Yearbook* 18, pp. 278–99. Thousand Oaks, CA: Sage.
- Leiss, W. (1996) Three phases in the evolution of risk communication practice, *The Annals of the American Academy of Political and Social Science* 545 (May), 85–94.
- Lofstedt, R. E. (2004) Risk communication and management in the 21<sup>st</sup> century, *AEI-Brookings Joint Center Working Paper No. 04-10*, <http://ssrn.com/abstract=545724>
- Renn, O., Webler, T. and Wiedemann, P. (eds.) (1995) *Fairness and Competence in Citizen Participation, Evaluating Models for Environmental Discourse*, Dordrecht: Kluwer Academic Publishers.
- Rowan, K. E. (1994) The technical and democratic approaches to risk situations: their appeal, limitations, and rhetorical alternative, *Argumentation* 8, 391–409.
- Rich, R. C., Edelstein, M., Hallman, W. K. and Wandersman, A. H. (1995) Citizen participation and empowerment: the case of local environmental hazards, *American Journal of Community Psychology* 23 (5), 657–76.
- Rowe, G. and Frewer, L. J. (2000) Public participation methods: A framework for evaluation, *Science, Technology, & Human Values* 25 (1), 3–29.
- Sandman, P. (1994) Risk communication, in R. A. Eblen and W. R. Eblen (eds) *Encyclopedia of the Environment*, pp. 620–23. Boston, MA: Houghton Mifflin.