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Risk Communication
Information about and Participation in Legal Decision Making regarding Nuclear and other High-Risk Technologies

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1 Foreword

The rising concern of the public about the safety of modern technology and new substances like nanoparticles has led to an increasing demand for more information and participation from the consumers, from special stakeholder groups and NGOs as well as from the public at large[1].

The need for risk communication was first voiced in Europe in the 1960s, at that time directed mainly at nuclear power plants, reprocessing facilities or waste incinerators, later focussing on the installations of the chemical industry and on facilities for genetic engineering. Nowadays not only the issues of ambient risks, but also of consumer risks, caused by potentially hazardous food items, chemicals, pharmaceuticals, pesticides and herbicides are objects of public dialogues[2].

Risk communication is the sharing of factual information, hypotheses, interpretations, beliefs and preferences, both scientific and social, on all questions of risk management, including the character of a technological risk, its acceptability and the adequate political and legal responses[3]. Risk communication can be conducted in different contexts — from a closed exchange within an elite group of experts to a public discourse between authorities, scientists, the industry, NGOs and concerned individuals. Depending on the context it can serve as

— a component of public participation in the process of administrative risk management,

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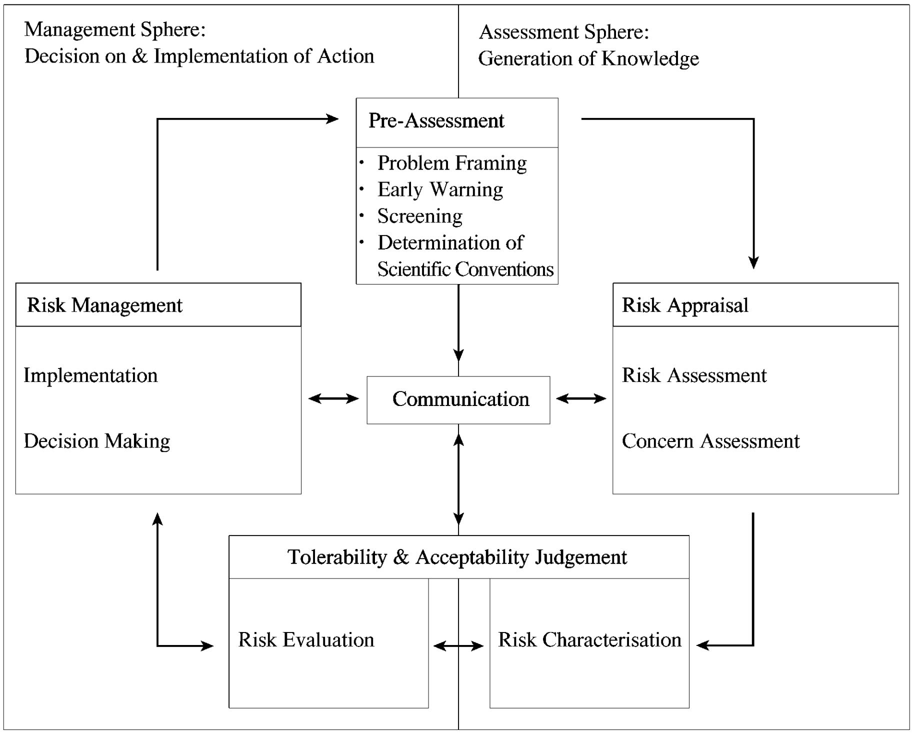
1) Renn, A comment to Ragnar Lofstedt, Risk versus Hazard. How to Regulate in the 21st Century, European Journal of Risk Regulation 2 (2011), p. 197.

2) Renn, (supra N.1), p. 197.

3) Fisher, Risk Regulation and Administrative Constitutionalism, Hart Publishing, Oxford, 2007, p. 20.

IRGC (2005) Risk Governance Framework



— part of a public discourse on a risk related legislative initiative or
— a public warning or recommendation about how to deal with a specific hazardous event.

The following analysis focusses on the two purposes mentioned first: risk communication as an instrument of legal decision making, that is: administrative and legal risk governance.

Risk communication today is regarded as a centerpiece of risk governance — as can be seen by the visual model of risk governance created by the International Risk Governance Council[4].

4) International Risk Governance Council (IRGC), White Paper on Risk Governance, Towards an Integrative Approach, 2005, http://irgc.org/wp-content/uploads/2012/04/IRGC_WP_No_1_Risk_Governance_reprinted_version_3.pdf, p. 13. The IRGC is a non-profit and independent foundation whose purpose is to help improve the understanding and governance of systemic risks that have impacts on human health and safety, on the environment, on the economy and on society at large. Its board members are drawn from governments, industry, science and non-governmental organizations worldwide.

Thus we need to start with some considerations about the phenomenon of risk and relevant aspects of risk governance.

2 Risk and Risk Governance

2.1 The Issues of Uncertainty and Ignorance

In decision theory the term "risk" usually refers to the expected value of an adverse effect, i.e. its probability and its gravity. If its probability is unmeasurable, decision theory speaks of "uncertainty". If, due to a lack of knowledge, even the very existence of an adverse effect is unknown, we have a case of "ignorance". In the following, however, I will use the term "risk" in a broader sense, comprising all three components mentioned, as the possibility of an adverse effect.

Contemporary science grants us the opportunity to continuously increase the understanding of the physical and social world. As it reveals more and more of the world's complex interdependencies, science allows us to intervene more specifically if considered necessary. But science also provides us with a continuously increasing understanding of how much we do not know. It is this growing awareness of our lack of knowledge that made the European Union and its members, many other countries and international conventions[5)] base their risk governance on the precautionary principle. Measures of precaution are meant to regulate the impact of technologies or other innovations which raise a threat of harm to human health or the environment without full scientific certainty about cause and effect and the probability of their realization. If risk governance under the precautionary principle is performed in situations of uncertainty, this calls for a specific perspective on the phenomenon of risk.

This is the case, because in cases of uncertainty, regulations and risks are inextricably intertwined. This is obvious in cases where permissive regulation allows damage to occur. But also a preventive stance may impart adverse effects, e.g. economic damage for a country having opted against a new technology, health risks for patients not being treated with a new medication because of the fear of unknown side effects, or simply unjustified restrictions of civil rights[6)]. By opting out of nuclear energy, for

5) As an overview cf. Maguire/Ellis, The Precautionary Principle and Risk Communication, in: Heath/O'Hair, Handbook of Risk and Crisis Communication, 2010, p.134 n. 1.

6) Scherzberg, Risikosteuerung durch Verwaltungsrecht, Veröffentlichungen der Vereinigung der Deutschen Staatsrechtslehrer, 2004, p. 225; Gleich, Vorsorgeprinzip,

example, Germany will have to face risks of insufficient availability of other environmental friendly energy sources.

Thus in case of regulations based on uncertainty we have to consider two types of risk: the possible harm caused by a specific technology or substance — which I call "1st order risk" — and the possibility of damage being caused by overregulating or misregulating it. These risks of unwanted effects of measures of risk governance which are based on — later on — falsified assumptions I call "2nd order risk"[7].

Taking into account the existence of 2nd order risks means to accept that in an uncertain world risk can never be avoided. Preventing one risk will inevitably open up another. Risk prevention is always risk substitution based on risk-risk trade-offs[8]. Thus risk and uncertainty are not threats which can be diminished, but constant elements of modern life. Life cannot be turned into a risk free zone. All we can do is to develop strategies about how to decide which risks and what kind of uncertainty we prefer to accept on the basis of present day knowledge.

2.2 The Limits of Science

Traditional risk assessment rests upon the belief in the efficiency of science. Regulations such as the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) rely on scientific evidence in evaluating the harms and benefits to society associated with particular measures and policies. An assessment based on science can obviously not at the same time be based on political schemes or interests. The SPS Agreement makes this point very clear when it contrasts "scientific evidence" with disguised restrictions on international trade. Whilst independence from political reasoning indeed should be a basic property of any scientific endeavor, it remains to be seen whether science can really provide for the clear and "objective" answers decision-makers expect:

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in: Bröchler/Simonis/Sundermann (Eds.), Handbuch Technikfolgenäbschatzung, 1999, p. 292.

7) Scherzberg, (supra n. 6), pp. 219-220; Karthaus, Risikomanagement durch ordnungsrechtliche Steuerung: die Freisetzung gentechnisch veränderter Organismen, 2001, p. 87-88; Sunstein, Laws of Fear, Beyond the Precautionary Principle, 2005, pp. 99-102; Gleich, (supra n. 6), p. 288.

8) Lofstedt, Risk versus Hazard. How to Regulate in the 21st Century, EJRR 2/2011, p. 149, 163.

harmful, yes or no? Let us explore this in three steps.

At first we have to note that a particular technological innovation may lead to a multitude of adverse effects. Human health may be threatened by toxicity, insufficient nutrition or unexpected cross-effects. Environmental issues may be biodiversity and toxicity to flora and fauna[9]. In the case of nuclear energy mainly the radiation of a nuclear accident and of the nuclear waste need to be considered. Economic losses may occur if these and other external effects of a technology are not internalised. There may also be social impacts like unease about the new technology or the loss of public trust in authorities to handle possible threats, making it more difficult to introduce new technologies in the future.

To ensure completeness of the assessment, these and all other possible effects would have to be taken into consideration. But it is simply not feasible to explore all effects[10]. Constraints are time and money. Thus often enough, cumulative or indirect effects are omitted[11] and their multitude is narrowed down to immediate and severe consequences to nature and to human health. This choice, sometimes called the "framing of the risk"[12], is political and cannot be based on science. Treating an effect as relevant and qualifying it as "adverse" presupposes a volitive decision[13].

Secondly the notion of completeness calls for the comparison of all relevant effects including their different qualities. For example aspects like severity, immediacy or reversibility are to be considered[14]. These qualities, however, are mostly incommensurable. This finding applies even more to the trade-off between potential harms and benefits and between different forms of risk-distribution[15]. Regarding nuclear power plants the advantage of relatively cheap and environmentally friendly energy has to be weighed against the risk of a nuclear accident and the — at least in Germany — unsolved problem of repositories for high level nuclear waste. To weigh and compare these risks is a matter of social and political

9) Stirling, On Science and Precaution in the Management of Technological Risk: a Synthesis Report of Case Studies, 1999, p. 10.

10) Rat von Sachverständigen für Umweltfragen, Umweltgutachten 2004 - Umweltpolitische Handlungsfähigkeit sichern, p. 658.

11) Stirling, (supra n. 9), p. 11.

12) Cf. IRGC, (supra n. 4), p. 13.

13) Rat, (supra n. 10), p. 647.

14) Stirling, (supra n. 9), p. 11; Scherzberg, (supra n. 6), p. 231.

15) Stirling, (supra n. 9), p. 11; Scherzberg, (supra n. 6), pp. 231-232.

judgment[16) — "sound" science is of no help.

Thirdly, science is often unable to provide a statistical probability for the manifestation of an adverse effect. To provide scientific evidence for a certain benefit of a new technology or substance is relatively easy — that is what the innovation is created for. But regarding its side effects, science mostly offers only estimates based on deliberately chosen premises which may lead to contradicting results. This is the case because most side effects develop only during the application of the technology or substance in practice — transforming the whole society into a laboratory. Often the cause of a particular adverse effect is also a combination of mutually interacting variables like operational errors and flaws in the design of the technology, as was the case in Three Mile Island and Chernobyl[17)]. In such cases the assessment of the probability of the risk is hardly possible, as the contradicting results of scientific risk assessment show in the area of nuclear energy[18)].

Almost invariably technological risk disputes involve conflicts over what is the available science and how it should be interpreted[19)], and even more how to address uncertainty which may result from the simple lack of knowledge, a systematic and random error in modelling, from effects due to random events or the limited amount of variables and parameters uses in a model. Since risk assessment invariably relies on modelling tools and it is difficult to assess whether a model is a constructive simplification or a misunderstanding of reality, and risk assessment also needs to take into account the vagaries of errors in human behaviour, there will always be methodological, epistemological and even ontological problems inherent in determining whether a threat exists and what its nature is[20)].

Without a clear picture of the likelihood of adverse effects, it is impossible to determine a rational course of action scientifically — a fortiori, if science does not even indicate the possibility of an adverse effect. Naturally, "the absence of evidence" should not be portrayed as "evidence

16) Stirling, (supra n. 9), p. 10.
17) Fisher, (supra n. 3).
18) Cf. Scherzberg, Der Ausstieg aus dem Restrisiko - Fukushima und die Folgen für die deutsche Risikodogmatik, in: Hendler (ed.), Jahrbuch des Umwelt- und Technikrechts, 2012, pp. 7-26.
19) Fisher, (supra n. 3), p. 16.
20) Fisher, (supra n. 3), p. 7.

of absence"[21]. On the contrary, practical reason forbids us from excluding adverse effects of sustained impacts of civilization on the environment[22]. This is the lesson to be learnt from the chlorofluorocarbon (CFC) disaster. The European Environment Agency comments:

> "There can be little doubt that a conventional risk assessment, in say 1965, would have concluded that there were no known grounds for concern. It would have noted that CFCs were safe to handle, being chemically very inert, [. . .] and having very low levels of toxicity. [. . .] The assessment might have pointed out that it was not known what happens to CFCs when they are released to the atmosphere, but would no doubt have added that they had been released for more than 30 years with no apparent harm being done."[23] The harm, however, was merely not apparent yet.

2.3 The Rationale of Risk Governance

If there is no sound scientific way to address the issues of the uncertainty and incommensurability of effects and the incompleteness of their analysis[24], risk assessment is a partly volitive operation[25] and the rationale of a decision based not only on science must be developed[26]. What needs to be done? Let me give you four suggestions:

— As a *first requirement*, administrative risk control must neither neglect issues of uncertainty and ignorance, nor prevent a gain of knowledge[27]. Recognizing the existence of 2nd order risks may

21) European & Social Research Council (ESRC), The politics of GM food. Risk, science & public trust, Special Briefing 5 (1999), p. 7.

22) Scherzberg, (supra n. 6), p. 252; Gleich, (supra n. 6), pp. 287-288.

23) European Environmental Agency (EEA), Late lessons from early warnings: the precautionary principle 1896-2000, Environmental Issue Report 22 (2001), p. 82.

24) Stirling, (supra n. 9), p. 10, 12.

25) Scherzberg, (supra n. 6), p. 249; Dose, Politisch-administrativer Umgang mit Nichtwissen in: Böschen/Schneider/Lerf (Eds.), Handeln trotz Nichtwissen. Vom Umgang mit Chaos und Risiko in Politik, Industrie und Wirtschaft, 2004, p. 3; Holland/Kellow, Trade and risk management: exploring the issues in: Robertson/Kellow (Eds.), Globalization and the Environment: Risk Assessment and the WTO, 2000, p. 238.

26) Douglas/Wildavsky, Risk and Culture, 1982, p. 194.

27) Scherzberg, (supra n. 6), p. 233.

mean to keep decisions open to revision by continuous monitoring and evaluation, and sustain the ability of society to learn. Thus it calls for controlled procedures of trial and error which enable authorities to detect the manifestation of unknown risks at an early stage and allow for their confinement[28]. Simultaneously however, risk management should also investigate alternative techniques and substances with similar benefits and reduced uncertainty.

— A *second requirement* is to explicitly address the underlying assumptions of the scientific risk evaluation[29]. By that it becomes transparent for decision-makers and the public what effects have been considered and how they are rated. Such transparency would allow for discourse on the choices made. It would also display the inevitable simplifications that come with any choice of that kind. Transparency is required especially with reference to uncertainty and ignorance. As we learn from Charles Perrow, there appears to be an inclination to resort to traditional, probabilistic assessment techniques where they are not applicable[30]. Mainly when transferring the results from the scientific community to decision-makers and the public, scientists need to clarify which questions at present cannot be answered[31].

— Since risk assessment is a value-based process, it inherently and inevitably presupposes the interaction of science and society. Naturally there are conflicting, incongruent social values and resulting options. Arrow's Impossibility Theorem[32] teaches us that trying to aggregate those various values is a futile exercise. Therefore the decision on if and how to introduce a new technology or handle a new risk phenomenon falls to the political system[33]. The *third requirement* would thus be for the political system to establish clarity about the necessity of political — and this means qualitative — risk evaluation and to resume its responsibility for it, instead of resorting

28) Scherzberg, (supra n. 6), p. 258.

29) Stirling, (supra n. 9), p. 12.

30) Perrow, Normal Accidents: Living with High-Risk Technologies, 1984.

31) Dose, (supra n. 25), p. 14.

32) Arrow's theorem says that it is impossible to design a social welfare function that satisfies the different preferences of several individuals at once. Stirling, (supra n. 9), p. 12.

33) Sundermann, Constructive Technology Assessment, in: Brochler/Simonis/Sundermann (Eds.), Handbuch Technikfolgenabschätzung, 1999, p. 122.

to the alleged authority of "sound science"[34].

— Qualitative risk evaluation concerns fundamental human values and resources;[35] it has to answer the question of social acceptability of risks to life, health, and collective goods; it has to weigh different risk alternatives and through all of this it has to maintain society's balance between innovation and protection.

It is well known from risk perception research that people assess and evaluate hazards and risks[36] in a highly differentiated manner. There is hardly any correlation between the ranking of hazards according to statistics on expected annual mortality and the ranking of the same hazards in the eyes of worried individuals[37]. People's risk perception does not depend on the degree of probability and the scale of exposure but on psychological, social or cultural variables like voluntariness, familiarity with the risk, trust in the authorities, media coverage, controllability of the risk or risk and benefit distribution[38]. This is the case, because there is no tool to objectively measure the value or burden of uncertainty.

Instead risk perception — like other perceptions — is formed by common sense reasoning, personal experience, social communication and cultural traditions[39]. In relation to risk it has been shown that uncertainty is linked with certain expectations, ideas, hopes, fears and other emotions.

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34) Bartsch, Schadensbegriffe in Zusammenhang mit Europäischen Regelungen zu gentechnisch veränderten Pflanzen, in: Potthast (Ed.), Ökologische Schäden - begriffliche, methodologische und ethische Aspekte, 2004, p. 2; Hennen, Partizipation und Technikfolgenabschätzung, in: Bröchler/Simonis/Sundermann (Eds.), Handbuch Technikfolgenabschätzung, 1999, p. 565, Meyer-Abich, Akzeptabilität von Techniken in: Bröchler/Simonis/Sundermann (Eds.), Handbuch Technikfolgenabschätzung, 1999, p. 309, 311, 316.

35) Meyer-Abich, (supra n. 34), p. 316.

36) Hazards characterize the inherent properties of the risk agent and related processes, whereas risks describe the potential effects that these hazards are likely to cause on specific targets; cf. IRGC, (supra n. 4), p. 19.

37) Covello, Strategies for Overcoming Challenges to Effective Risk Communication, in: Heath Robert L./O'Hair, H. Dan (ed.), Handbook of Risk and Crisis Communication, 2010, p.143, 144;

38) Covello (supra n. 37) p.144; Scheer/Gold/Benighaus et al., Communication of Risk and Hazard from the Angle of Different Stakeholders, BfR-Wissenschaft 11/2010, http://www.bfr.bund.de/cm/350/communication_of_risk_and_hazard_from_the_angle_of_different_stakeholders.pdf, p. 29, 32.

39) For this and the following see IRGC, (supra n. 4), pp. 31-34.

In situations of not knowing about the consequences of an action people develop — and follow relatively consistently — patterns of creating images of risks and evaluating them. These are patterns of qualitative risk evaluation.

For example, risks the realization of which depends on other people's activities — like terroristic attacks — are judged to be greater than risks representing a challenge to one's own strength like in sports or risks seen as a blow of fate such as national disasters[40]. Risk from activities which may possibly have delayed effects are judged to be greater than risk from activities viewed as having immediate effects. Risks from activities with a history of major or frequent minor accidents are easily overestimated compared to risk without such history[41]. Furthermore factors like

— the "availability" of an event (how often one is reminded of it),
— the conformity of one's own response to that of everyone around
— the so-called "confirmation bias" (once a belief about a risk is formed, contrary information is ignored and ambiguous data is interpreted as proof) and
— the general aversion of people to uncertainty as such

influence the understanding of risk and decide about its public perception[42].

Such patterns and modi of responding to risk, ignorance and uncertainty affect the level of public trust or — if lost — the amount of public fear, anger or outrage. The way these feelings are triggered and expressed is often characteristic for a people or a civilisation and belongs to their specific culture. In many European countries, for example, genetic engineering in agriculture and genetic modified food encounters severe resistance, while gene technology finds broad acceptance in the field of pharmacological research. While this distinction seems completely intelligible to Europeans, it confuses most American authors[43]. Another example of cultural risk evaluation would be road traffic. A German all-time-high of 19,000 fatalities due to traffic accidents in 1970, figuring today

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40) Cf. IRGC, (supra n. 4), p. 32.

41) Covello, (supra n. 37) p. 145; for an overview on the psychological research cf. IRGC, (supra n. 4), pp. 31-33.

42) Covello (supra n. 37), p. 149.

43) Robertson, GM foods and global trade, in: Robertson/Kellow (Eds.), Globalization and the Environment: Risk Assessment and the WTO, 2000, pp. 207-208, 217.

at 3,600, neither kept people from using cars, nor motivated the public to call for general speed limits as they are implemented in most other countries. Think of the uprising, though, if it turned out that GMOs cause a comparable amount of fatalities a year. Global warming is another acute instance showing the relevance of culture in risk evaluation: just remember the difference in viewpoints between most of Europe and the US about the handling of climate related risks[44]. Obviously there are risk-averse and risk-friendly communities and different viewpoints about the evaluation of and the adequate response to the different types of risk in modern society[45].

A *fourth requirement* for risk governance takes up this value-related element of risk governance and calls for the provision of a societal risk dialogue[46].

2.4 A first conclusion

My previous findings indicate that the assessment of risks inherently depends on the contemplation of social values and conceptions. Risk — as a whole — is a construct[47]. This starts with the question of which classes of effects to consider, of how to rank the concerned individual and collective goods and of how to evaluate the trade-off between the uncertainty of known or unknown hazards and the certainty of known benefits of an innovation. It ends with the political decision under which assumptions and conditions the assessed risks are acceptable.

If risk is not a purely objective and quantitative phenomenon, but a subjective, value based qualitative concept, risk governance cannot be understood as a simple "technical" selection of measures of precaution in order to minimize adverse effects, but must be regarded and conducted as a process to reflect on, define and select the relevant social values and preferences and thus ensure both scientific validity and political accountability.

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44) Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WBGU), Welt im Wandel: Strategien zur Bewältigung globaler Umweltrisiken, 1998, p. 135, 140.

45) Robertson, (supra n. 43), p. 3.

46) Deane, Public Perceptions, risk communication and biotechnology, in: Robertson/Kellow (Eds.), Globalization and the Environment, 2000, pp. 111-114.

47) Cf. IRGC, (supra n. 4), p. 23; Scherzberg, (supra n. 6), p. 258; Sunstein, (supra n. 7), pp. 108-110; Douglas, (supra n. 26), pp. 186-198; Deane, (supra n. 46), p. 108.

This is where risk communication becomes relevant. It allows for an interplay between governmental institutions, economic and academic actors, NGOs and other civil society members in the process of defining and evaluating the conflicting interests and deciding on how to distribute the burden of uncertainty. It allows politics to interact with society to determine the acceptability of risks as they interact with science to verify the known facts. It enables the bodies of legal decision making to take into account the social and moral perceptions of and the values and priorities in regard to the risks at stake and on the other hand enables stakeholders and the public to understand the rationale of the final risk decisions of the authorities.

This is the case not only to ensure the fair chances of innovation in society but also to ensure the transparency and legitimacy of the political processes of risk management itself[48]. Neglecting public concern may lead to a growing mistrust of the institutions that are engaged in risk management and to an increasing scepticism towards their ability to act in democratic response to society[49]. Furthermore, if a new technology evokes public resistance, this may well force industry to renounce the innovation even if the specific regulations are permissive, as we saw in the fields of genetic engineering in Germany. Therefore it is imperative to address public concern and respect and integrate public risk evaluation[50].

Thus, risk communication serves the following purposes:

— to make the risk situation and the risk decision transparent to the concerned public, possibly fostering tolerance for conflicting viewpoints and understanding for the need to find compromises (information)
— to enable the concerned public to voice their preferences in relation to a specific risk (participation)
— to enable the authorities to assess the social acceptability of the risk and consider the result in the decision making process (representation), thus ensuring its quality, and
— to enable the concerned public to prepare for and respond to the risk situation and the final risk decision according to their own risk

48) Hennen, (supra n. 34), p. 565.
49) Fisher, (supra n. 3), pp. 10-11.
50) Deane, (supra n. 46), pp. 114-115.

assessment (empowerment).

If done in a distinguished way, risk communication can, as the International Risk Governance Council concludes, "have a major impact on how well society is prepared to cope with risk and react to crisis and disaster."[51)]

3 When and how risk communication ?

In which way, at what stage of decision making and by what means risk communication is performed best, depends firstly on the legal frame and secondly on the social culture in question. For example, communication and participation are most useful when they can possibly influence the outcome of decision making. Looking from the perspective of public administration they are potentially influential only as far as the administrative body is given a considerable margin of appreciation or discretion.

3.1 Challenges

A German survey, carried out on behalf of the Federal Institute for Risk Assessment, identified as possible obstacles to successful risk management:

— late and incomplete information,
— a lack of transparency, and
— an over- or underestimation of the risks in question caused by distorted risk perception and poor communication skills[52)].

Further challenges for risk management are caused by the divergent goals and motivation of the different stakeholders, like media, NGOs, scientists, industry and public authorities, different understandings of the concept of risk and hazard and the mutual presumptions regarding the instrumentalisation of these topics[53)]. Since the knowledge, preconceptions, interests and intentions of the parties involved differ, there is always a risk of miscommunication, manipulation and emotional entanglement. Thus, the results of risk communication are uncertain and cannot be taken for granted.

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51) Cf. IRGC, (supra n. 4), p. 5.
52) Scheer/Gold/Benighaus et al., (supra n. 39), p. 127.
53) Scheer/Gold/Benighaus et al., (supra n. 39), p. 127.

3.2 Practical Keys

From these observations some practical keys for successfully performing risk communication can be derived: [54)]

— Risk communication should not be delayed until the development of the new technology is completed or the innovation process is ready to be launched. Rather, the discourse should begin as soon as new technologies or phenomena loom[55)] and it should be continued through all the stages of risk management, including the subsequent monitoring.

— Risk communicators should support adequate media coverage by providing information which is trustworthy, first-hand, brief, and concise, and by offering sufficient scientific background and human interest stories.

— A collaborative formulation of the aspects of the risk which need to be taken into account during the risk assessment is preferable. This includes i.a. a co-definition of the scope of the assessment process or policy in question. In most cases risk communication needs to address not only the question whether a certain risk is acceptable, but also — if it is — how it is dealt with best, i.e. which monitoring and oversight mechanisms need to be installed.

— An inclusion of the full spectrum of parties interested in or affected by the decision is obligatory. In the process the main conflicting opinions among the public and stakeholders should be introduced and it should become apparent, how far differing roles and interests — as profit-driven businesspeople, risk avoidance managers, concerned or affected individuals or NGOs — lead to different interpretations of the same risk situation. At the same time the discourse needs to be moderated in a way that is considered fair and that accepts all the different perspectives — unless falsified — as equally valuable[56)].

— Available scientific data must be delineated. The limits of any scientific statement as well as the dependence of such statements on

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54) Covello, (supra n. 37), p. 149-153; regarding successful management of risk participation cf. Dietz/Stern (ed), Public Participation in environmental assessment and decision making, Washington, 2009, pp. 227-230.

55) Stirling, (supra n. 9), p. 25; Sundermann (supra n. 33), p. 121.

56) Stirling, (supra n. 9), p. 12.

framing assumptions must be clearly addressed[57]. For that a clear distinction has to be made between hazard — as the potentially dangerous properties of a substance or installation — and risk, understood as both the properties of the substance, the exposure to humans and the environment and the scenario of its uses and their probability[58].

— The competent public authorities should explicitly name the values or conceptions that eventually become the basis of the decision. The more they are willing to consider the results of the communication process, the more likely the parties are to engage in it seriously. Therefore it is essential to clarify at the beginning of the process that the responsible authority is committed to open-minded considerations of its outputs.

— As risks are perceived inter alia according to their familiarity, controllability and voluntariness, efforts to discuss these aspects are as valuable as efforts to reduce the hazard itself. For restoring trust in the controllability of a risk, the sharing of power, e.g. by establishing and assisting community advisory committees, or supporting independent research, audits and monitoring can support the acceptability of the risk in question.

— At any stage of the discourse, it must be apparent to everybody how far the respective decision is open to revision.

— The public must be made aware that remaining risks due to yet unknown hazards could only be avoided if society were to renounce any and all innovation. Even "unsuspicious" technologies may entail unexpected effects[59].

In Germany the setting up of a body for "social handling of risk" within the Federal Institute for Risk Assessment was proposed[60]. Without prejudging the future findings of such a body, two recent German

57) Dressel, BSE — The New Dimension of Uncertainty: the Cultural Politics and Decision-Making, 2002, p. 192-197; Sunstein, (supra n. 7), p. 110; Hennen, (supra n. 34), p. 566; Dose, (supra n. 25), p. 14-15.

58) Renn, (supra n. 1), p. 202.

59) For instance, the direct current used in solar electricity systems is prone to creating self-sustaining electric arcs which may spark blazes, and some studies indicate that radiation from cellular phones may render males sterile.

60) Scheer/Gold/Benighaus et al., (supra n. 39), p. 129.

experiences suggest that successful risk communication may be achieved best in an institutionalized societal risk discourse, provided by a panel or commission with representatives of all relevant groups and stakeholders, where an exchange of information and perceptions can be initiated over a span of time without pressure to immediately come to a conclusion.

The best example of such a discourse is probably the proceedings of the German government's NanoKommission. This commission aimed at fostering the responsible use of nanomaterials in line with the precautionary principle, preventing risks and advancing sustainable innovation. After two working phases between 2006-2008 and 2009-2011 it issued its final report "Responsible Use of Nanotechnologies"[61], inter alia about the preliminary assessment of benefits and risks and about regulatory processes under the principle "Green Nano". The NanoKommission comprised eighteen permanent members representing a variety of stakeholder groups. The members' work was supported by four Issue Groups, each consisting of 20-25 members representing ministries and public authorities, research and industry, environmental, consumer and women's organizations, trade unions and churches. Thus more than a hundred experts took part in the discourse and contributed to the final report. The report documents the framing of the risk, the shared assumptions, the questions on which a broad consensus could be achieved, the controversial issues, and each participant's opinions in this respect. Thus it contributes to transparency and helps to build trust in the government's willingness to communicate and to respect the different perceptions of nano-related risks. As a result, major German companies and industry organizations included explicit commitments to the NanoKommission's principles in their websites, position papers and guidelines.

A second example is the public mediation concerning the dispute about the construction of a new underground train station in Stuttgart ("Stuttgart 21"). This mediation took place after a fierce and violent resistance from large parts of the population against the project. The long and detailed mediation, which addressed all objections raised and proposed several modifications, was completely broadcasted on television and found a large

61) Cf. http://www.bmub.bund.de/en/service/publications/downloads/details/artikel/responsible-use-of-nanotechnologies-1/

number of viewers. It played a major role in creating public appreciation of the benefits and public acceptance of the costs of the project, so that a referendum on its further funding by the state of Baden-Württemberg was won by the proponents by almost 59% of the votes[62].

3.3 A closer look: linking science and deliberation

Risk communication requires a complete gathering and considering of relevant information. This of course includes both information based on scientific analysis and common sense based deliberations. In many reports the US National Research Council has given much consideration to the link of science and deliberation[63].

As it stated in its pioneering publication "Understanding risk" (1996): "Risk characterization is the outcome of an analytic-deliberative process. Its success depends critically on systematic analysis that is appropriate to the problem, responds to the needs of the interested and affected parties, and treats uncertainties of importance to the decision problem in a comprehensible way[64]." The required integration of science into risk communication is a translation process which can be sensitive for three reasons:[65]

— Due to the uncertainty involved in risk assessment, transparency is needed about the assumptions and estimates on which the scientific approach is based. "Trust, understanding, and constructive criticism can emerge only when there is awareness of uncertainty and assumptions. Careful analysis . . . can identify assumptions and uncertainties, examine how much they matter, and thus tighten the focus of further analysis and allow honest discussion about what

62) A summary of the events is given by Landeszentrale für politische Bildung Baden-Württemberg, http://www.lpb-bw.de/schlichtung_s21.html; for the results of the mediation see Heiner Geißler, Schlichtung Stuttgart 21 plus, http://www.schlichtung-s21.de/fileadmin/schlichtungs21/Redaktion/pdf/101130/2010-11-30_Schlichterspruch_Stuttgart_21_PLUS.pdf

63) The following paragraphs are taken from National Research Council, Stern/Fineberg (ed.), Understanding Risk: Informing Decisions in a Democratic Society. Washington, DC: The National Academies Press, 1996; http://www.nap.edu/openbook.php?record_id=5138&page=2.

64) Stern/Fineberg, (supra n. 63), p. 3.

65) For the following cf. Dietz/Stern, (supra n. 54), pp. 234-235.

underpins conclusions and decisions"[66].

— More often than not, due to different fundamental assumptions, the validation of facts or the estimation of risks differ even among scientists and/or across scientific disciplines. Therefore risk communication must assure that all decision-relevant information is accessible and the interpretations given by scientists and the authorities are made visible to the participants. Also among participants there may be different values, interests and concerns and what is regarded a relevant factor from a scientific viewpoint is not necessarily regarded relevant from a layman's point of view. Thus an effective analytic-deliberative process needs to deal with both facts and values and the question whether and in which way they are agreed upon or contested.

— Participants in risk communication lack scientific background in order to properly understand and interpret complex scientific information. Scientific models are difficult to follow and the rules for validating facts may differ between scientists and laymen. Especially in the area of qualitative risk assessment the perspectives of experts and laymen often differ. Also the public may be sceptical about the neutrality of scientific analyses whereas scientists may be sceptical about the value-laden approach of the participants. To bridge this gap it is best to include experts from NGOs or independent academic institutions which enjoy the trust of the participants or consumers to whom the risk communication is addressed, and ensure an open discussion of the assumptions and uncertainties and the options about how to deal with them.

3.4 Risk communication as an element of public participation

Depending on the goal of the involvement of the public, risk communication may need to include participation procedures. As Dietz and Stern, editors for the US National Research Council, summarize their survey of several risk assessment studies:

> "It could be said that, under many conditions, processes that were more participatory along the dimensions of breadth, timing, intensity and influence led to improved overall outcomes, in regard to the

66) Cf. Dietz/Stern, (supra n. 54), p. 236.

capacity building of the participants and the quality and legitimacy of the decision[67]."

An experimental study in the US showed that people who believe that a decision resulted from a public participation process are more likely to accept the decision.

In this experiment, all participants received the same information about the risks and benefits involved in using a nuclear generator. However some were told that decisions about mission planning, objectives, design and the use of the generator were based equally on active public participation and on expert knowledge, others were told the decisions were based on expert statements only. "The individuals who were told that the decision incorporated public participation were significantly more supportive of the decision itself, as well as the process by which the decision was reached. They also expressed greater support for similar future missions, even though the two groups ranked risks from nuclear generator use similarly[68]."

In another study, people were involved in so called deliberative polls, addressing a number of public policy issues; they were i.e. provided with balanced briefing on the policy issue, engaged in informal discussions in their everyday milieus and participated in a professionally facilitated small-group deliberation with opportunities to question experts. According to the authors of the study the participatory process increased participant's capacity through learning and helped them to develop greater consensus on some aspects of their preferences. Also the participants were more likely to vote afterwards, thus they became politically more active[69].

The International Risk Governance Council developed a distinct classification of four types of risk situations and the appropriate focus of public participation[70].

According to this classification,

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67) Cf. Dietz/Stern, (supra n. 54), p. 85.

68) Cf. Dietz/Stern, (supra n. 54), p. 77, referring to J.J. Arvai, Using risk communication to disclose the outcome of a participatory decision-making-process: Effects on the perceived acceptability of risk-policy decisions, Risk Analysis, 23, (2003), pp. 281-289.

69) Cf. Dietz/Stern, (supra n. 54), p. 77, referring inter alia to Fishkin/Luskin, Experimenting with a democratic ideal: Deliberative polling and public opinion, Acta Politica, 40 (2005), pp. 284-298.

70) IRGC, (supra n. 4), pp. 47, 51-53.

IRGC: Risk Characteristics and their Implications for Risk Management (simplified by A.S.)

Knowledge Characterisation	Appropriate Instruments	Stakeholder Participation
1. ‚Simple' risk problems	→ Applying ‚traditional' decision-making	Instrumental discourse
2. Complexity-induced risk problems	→ Characterising the available evidence → Improving buffer capacity of risk target	Epistemological discourse
3. Uncertainty-induced risk problems	→ Using hazard characteristics such as persistence, ubiquity etc. as proxies for risk estimates → Improving capability to cope with surprises	Reflective discourse
4. Ambiguity-induced risk problems	→ Application of conflict resolution methods for reaching consensus or tolerance for risk evaluation results and management option selection	Participative discourse

— Simple risk problems (type 1) like known food and health risks need only an instrumental discourse between the directly affected groups, because the potential consequences are obvious and the values applied are not controversial.

— Complex risk problems, however, with insufficient or disputed data about risk agents, the dose-effect relationships or the vulnerability of the risk absorbing system (type 2) require transparency over the subjective judgments and thus an epistemological discourse in which scientists, stakeholders and public groups aim at finding the best estimates for characterising all the variables of the cost-benefit equation. Here participants from academia, government, industry and civil society should be selected according to their capability to bring new or additional knowledge to the negotiating table.

— If this leads to an acknowledgment of wide margins of uncertainty, the tools for risk type three apply, which comprises of all uncertainty induced risk situations. Here a reflective discourse needs to be initiated about the acceptability of trial and error strategies, the right margin of safety and appropriate other measures of precaution. Here government officials, the main stakeholders and other affected groups are meant to reflect in informal or formal settings (like round table, mediation or advisory committees) on the question of "how much uncertainty and ignorance are we willing to accept in exchange for some given benefit?"

— If the risks in question — may it be in regard to the scientific predictions or to the appropriate legal consequences in the light of values and priorities — are interpreted differently by stakeholders, the IRGC speaks of ambiguity induced risk problems (type 4) and calls for a participative discourse. Here a broad public input is needed as the focus lies on deliberating social values and moral issues raised by the need to weigh benefits and costs in the light of existing alternatives and persisting uncertainties. "The risk issues in this debate focus on the differences between visions of the future, basic values and convictions, and the degree of confidence in the human ability to control and direct its own technological destiny. These wider concerns require the inclusion within the risk management process of those who express and represent them"[71).

4 The Legal Perspective

4.1 Risk communication as a constitutional requirement and a requirement of European Law

Considering the above, risk communication is certainly a requirement of "good governance"[72). But how far is risk communication required by law? This of course depends on the legal order of each respective country. In Germany there would be three grounds for risk communication to be obligatory for the authorities involved:

— Risk communication is an important element of democratic transparency. Only if the assumptions and consequences of a legal decision are openly and widely discussed, would citizens be able to respond to it in a reflected way through their voting at democratic elections.

— Risk communication is an equally important element of an adequate and efficient conduct of the specific (nuclear or other) licensing procedure. As discussed above, decisions on high-risk technologies not only require scientific knowledge but also need to take into account questions of social risk preference. Therefore risk communication is imperative in order to gather all relevant information for the risk assessment. In order to enable the administrative body to assess the social impact of the risks in question, the procedure must include individual consultations and public hearings, especially if

71) IRGC, (supra n. 4), p. 46.
72) IRGC, (supra n. 4), p. 2.

the administration is given discretionary leeway or has to weigh risks and benefits of an installation.

— Last but not least: risk communication is an instrument to fulfill the state's duty to protect the life and health of its citizens and to empower them to exercise their human rights effectively. As far as individual health risks are involved, the concerned individuals have a right to be heard as an element of protecting their fundamental rights. This is referred to as the "procedural component" of their right to life and physical integrity.

The instruments of risk communication will of course differ according to the democratic system of the respective country and the procedure in question, especially between acts of parliament and administrative decisions. For example: in a system of representative democracy, acts of parliament are usually accompanied by public participation through referendum or plebiscite only if provided for by the constitution.

In the European legal order, the transparency of and participation in decision making processes in the area of environmental protection, which includes most cases of licensing of high-risk technologies, are guaranteed by the Aarhus Convention of 1998[73] (The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters) and consecutive EU-directives.

The Convention provides for:

- the right of everyone to receive environmental information that is held by public authorities ("access to environmental information"). This can include information on the state of the environment, but also on policies or measures taken, or on the state of human health and safety where this can be affected by the state of the environment. Applicants are entitled to obtain this information within one month of the request and without having to say why they require it. In addition, public authorities are obliged, under the Convention, to actively disseminate environmental information in their possession;
- the right to participate in environmental decision-making.

73) European Commission, Environment, The Aarhus Convention, http://ec.europa.eu/environment/aarhus/.

Arrangements are to be made by public authorities to enable the public affected and environmental non-governmental organizations to comment on, for example, proposals for projects affecting the environment, or plans and programs relating to the environment. These comments are to be taken into due account in decision-making, and information needs to be provided on the final decisions and the reasons for it ("public participation in environmental decision-making");

- the right to review procedures in order to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general ("access to justice")[74].

4.2 Risk communication in licensing processes according to former German nuclear energy law

Since 2002, German nuclear law does not allow for any new nuclear power plants to be licenced. As Section 7, paragraph 1 of the Atomic Energy Act states: "No further licences will be issued for the construction and operation of installations for the fission of nuclear fuel for the commercial generation of electricity or of facilities for the reprocessing of irradiated nuclear fuel." Furthermore, after the Fukushima disaster, the German Parliament decided that all existing licenses to operate such installations expire at the end of 2022.

Under the previous law, in force through 2002, the licencing procedure was subject to the following rules[75]:

Any person who constructs, operates or otherwise holds, or who substantially alters any installation for the production, treatment, processing or fission of nuclear fuel, or for the reprocessing of irradiated nuclear fuel had to obtain a license in accordance with Section 7, paragraph 1 of the Atomic Energy Act.

According to Section 7, para 2 of the Atomic Energy Act, this license could only be granted if the following prerequisites were fulfilled:

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74) European Commission, Environment, The Aarhus Convention, http://ec.europa.eu/environment/aarhus/

75) For the following cf. Philippe & Partners, Final Report on Survey of Licensing Procedures for new Nuclear Installations in EU Countries, http://ec.europa.eu/energy/nuclear/forum/opportunities/doc/legal_roadmap/20120907_final_report_licensing_survey.pdf, 2012.

- there are no known facts giving rise to any doubts as to the reliability of the applicant or of the persons responsible for the construction and management of the installation . . .
- every necessary precaution has been taken in the light of existing scientific knowledge and technology to prevent damage resulting from the construction and the operation of the installation;
- the necessary financial security has been provided to cover all legal liability to pay compensation for damage;
- all necessary protection is provided against disturbance or other interference by third parties (physical protection);
- the choice of the site of the installation, in particular with respect to non-contamination of water, air and soil, is not contrary to overriding public interests.

The Ordinance on the Procedure for Licensing of Installations under section 7 of the Atomic Energy Act (Nuclear Licensing Procedure Ordinance) constituted a formal procedure in which every person concerned could oblige the authority to deal with his/her objections.

As soon as the documents required for public inspection were complete, the licensing authority had to publish an announcement of the project in its official bulletin and in local daily newspapers circulating in the area where the installation was to be sited. An additional reference to the announcement had to be made in the Federal Bulletin.

The announcement needed to

— contain information about the applicant and about the site, type and size of the installation,

— indicate where and when the application and the respective documents would be available for inspection,

— contain the reference that the project requires an EIA — an Environmental Impact Statement, which is a description and assessment of the impacts of the project on human health, animals, plants and biological diversity, soil, water, air, climate and scenery, cultural properties and other physical products, including the relevant interactions between them,

— inform the public that any objections could be brought before a body specified in the announcement within the period available for public inspection,

— contain further information about the date of a hearing and
— indicate that the objections will be discussed at the hearing, irrespective of whether or not the applicant or any of the persons who have raised objections are present.

To enable the concerned individuals to exercise their right to object, certain application documents had to be made available for public inspection during office hours for a period of two months at the offices of the licensing authority and at a suitable location near the site of the project, with the request for raising any objections within this period. The publicized documents included

— the application,
— a safety analysis report prepared by the applicant which described the impacts of the project in terms of nuclear safety and radiological protection as far as they were relevant for the decision concerning the application. This report had to enable third parties to assess whether or not their rights may be affected by the impacts associated with the installation and its operation,
— a brief, readily understandable description of the installation and its likely effects on the public and the neighborhood,
— a description of the residual radioactive materials accumulating as well as data concerning the measures intended to be taken for the prevention of any accumulation of residual radioactive materials; for the safe utilization of accumulated residual radioactive materials and dismantled or dismounted radioactive components of the installation; for the regular disposal of residual radioactive materials or dismounted radioactive components in the form of radioactive wastes, including their intended treatment, as well as for the anticipated temporary storage of radioactive wastes until their ultimate storage;
— data relating to other environmental effects of the project which were relevant for approval decisions which, in individual cases, were to be included in the licensing decision as well as reports and recommendations concerning the procedure which were significant for the decision and had been submitted to the licensing authorities at the beginning of the procedure of participation.

Within two months after the publication of the documents, every individual was entitled to formulate objections and send them to the authority. Upon expiration of the public inspection period, further objections were not admitted unless they were based on special titles under private law.

After the end of this period, the objections were discussed during a hearing between the license authority, the applicant and the persons raising the objections. The hearing itself was not open to the public. The representative of the licensing authority presided over it, summarized the objections and asked the applicant to give statements on each of them. Everyone who had formulated an objection had access to the hearing and was usually given the opportunity to further explain their objections. The hearing in cases of licensing of nuclear power plants could last from several days to several weeks. In one instance, concerning the Konrad repository, this public enquiry lasted for about 200 days (spanning over a year in time).

Thus the former German nuclear energy law formally provided for sufficient public information and participation in nuclear licensing procedures. However, the former Atomic Energy Act, originating in 1960, did not aim only at minimizing risks but also at fostering the use of nuclear technology. Thus without specific grounds to withhold the license, administrative discretion had to be used in favor of the applications according of the Atomic Energy Act. As a consequence, the construction of new nuclear power plants was licensed although objections based on questions of safety and where to install a final repository for nuclear waste were unsolved.

Thus the administrative procedures of risk communication were not able to solve the fundamental dispute over nuclear energy in Germany. After the disaster of Chernobyl, a majority of the German population had lost their trust in the safety of nuclear energy and disapproved of the licensing of new nuclear power plants. This disapproval was partly expressed in violence. In my understanding, the conflict could not be solved because risk communication was limited to the public hearings on specific projects, and an institutionalized general societal risk discourse on nuclear energy was lacking, as it was later on successfully conducted in the case of nanotechnology by the aforementioned NanoKommission.

At least for Germany I would conclude that, if the fundamental choice pro or contra a certain technology is in question, risk communication can be effective only if it addresses not only specific projects on an administrative level, but the basic legislative decisions about the acceptability of the respective risks, and is designed in an institutionalized and representative manner.

5 Final Conclusions

Risk communication is a tool to deepen the understanding of the scientific bases of risk governance and of the value trade-offs at stake. Risk communication allows decision-makers to make informed decisions with regards to scientific knowledge and public preferences and the public to evaluate these decisions in the light of all available information.

If the acceptability of a certain technology is at stake, the German example calls for an institutionalized societal risk discourse.

At its best, risk communication can thus support credibility and acceptability of risk decisions[76]. But even if a society-wide consensus is not achieved, risk communication will contribute to a common understanding of the necessity to constantly discuss, (re)define and politically decide upon societal risk preferences in the light of uncertainties and conflicting interests and perceptions. Through this process the underlying cultural and political values and beliefs will become apparent, which at the end will decide whether the final legislative or administrative decision will be acceptable to the people.

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76) Deane, (supra n. 46), pp. 113-114.