THE SPATIAL DIMENSION OF RISK

How geography shapes the emergence of riskscapes

Edited by Detlef Müller-Mahn

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The Spatial Dimension of Risk

Through its exploration of the spatial dimension of risk, this book offers a brand new approach to theorizing risk, and significant improvements in how to manage, tolerate and take risks. A broad range of risks are examined, including natural hazards, climate change, political violence and state failure. Case studies range from the Congo to Central Asia, from tsunami and civil war-affected areas in Sri Lanka to avalanche hazards in Austria. In each of these cases, the authors examine the importance and role of space in the causes and differentiation of risk, in how we can conceptualize risk from a spatial perspective and in the relevance of space and locality for risk governance. This new approach – endorsed by Ragnar Löfstedt and Ortwin Renn, two of the world's leading and most prolific risk analysts – is essential reading for those charged with studying, anticipating and managing risks.

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Endorsements

'*The Spatial Dimension of Risk* offers fresh, practical ways of seeing risk, governance and space. It combines previously separate approaches: sociology of risk, geography of hazard and politics of policy. The authors invite us to think about war, flood, disease and terrorism in new ways – changing our thought as profoundly as Beck's *Risk Society* 20 years ago.' – *Benjamin Wisner, disaster management consultant with 44 years of experience and author of* Disaster Risk Reduction: Cases from Urban Africa *(Earthscan 2009),* Handbook of Hazards and Disaster Risk Reduction *(Routledge 2011) and* Disaster Management: International Lessons in Risk Reduction, Response and Recovery *(forthcoming Routledge 2013)*

'The book gives the floor to a central dimension of risk, namely its spatiality. Spatiality comes in many different disguises, in the Global South as well as in the North, be it state border policies, propagation of contagious diseases, distribution of drought or landslide risk, or the question on which scale a risk should be managed in a most optimal way. With the concept of "riskscapes", the book provides an innovative and comprehensive frame for these widely diverse aspects of risk.' – *Jakob Rhyner, Director of the United Nations University Institute for Environment and Human Security and Vice Rector in Europe of the United Nations University*

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Preface

Space plays an important role for risk production, but so far it has been paid relatively little attention in the theorizing of risk. The time dimension has occupied a more central position, since risk is essentially seen as a category that links the present with the future. This book is intended to make a contribution to the understanding of the intricate relationship between risk and space by discussing different conceptualizations of the two, and by exploring how they are related.

The examples of the relevance of space presented in the book are very diverse. In the case of natural hazards like floods, avalanches or landslides, the spatial dimension is obvious, because these risks can be localized and represented on maps. In the political geography of borders, conflicts and transboundary risk governance, risk is often related more or less directly to territorial units. Other types of risk, however, cannot so easily be associated with particular territories or places, as some recent experiences have shown: the Fukushima catastrophe for example was a local event with global consequences. Climate change is a global process with local consequences. Recent outbreaks of pandemic diseases like swine flu or SARS have been perceived as global threats, although their immediate impacts remained more or less locally confined. The production of risk in a local–global continuum can only be understood by taking into account different spatial levels, geographical settings and scalar effects. Space provides the arena for the overlapping of multiple risks in particular places and regions. The case studies in this book show that space may be addressed both as an analytical framework for the study of risk, and as an empirical tool for risk management, based on localizing, measuring, regionalization and mapping of particular risks.

Against this backdrop, the guiding question of the book is: ‘What makes risk a spatial phenomenon, and what can Geography contribute to its study and management?’ Of course, Geography does not hold any claim to exclusive competence in risk research, but the specific contribution of the discipline to the study of risk may be seen in its tradition of studying social and biophysical processes in spatial contexts, an interest in integrative approaches at the interface between science and social studies, and a professional sensitivity for questions related to space and scales.

The articles in this book mostly follow constructivist perspectives, which implies that risk is understood as an object of perception and negotiation within society. In this context, the concept of 'riskscape' is introduced to indicate how individual actors and social groups develop personal visions of risk and translate them into spatial settings. The notion of 'riskscape' has a metaphoric meaning that combines the idea of a territory or a landscape with that of risk. A landscape in this sense is a territorial unit that is characterized by mutual interactions between its elements, whereas risks are regarded as structuring phenomena that shape the landscape into a riskscape. The concept seeks to link materiality and meaning from an actor-oriented perspective. Similar to a landscape, the physical elements of a 'risky territory' form obstacles to and opportunities for the movement of people, and they are therefore part of their action frame of reference. The concept of the riskscape also allows the analysis of multiple risks and how people manage them. Riskscapes may therefore be understood as landscapes of multi-layered and interacting risks that represent both the materiality of real risks, and the perceptions, knowledge and imaginations of the people who live in that landscape and continuously shape and reshape its contours through their daily activities.

The chapters of the book present a wide range of conceptual approaches, case studies and riskscapes, but there are some similarities that can be explained by the fact that the authors – with the exception of Ortwin Renn who is a sociologist – are geographers based at universities in Germany, Austria and Switzerland. This has some influence on their thinking and the selection of empirical examples. Their shared interest is not simply their focus on territories or spatial containers, but the social constructedness of space, social practices of appropriation and formation of space, and the way individuals and societies give meaning to material objects situated in space. In other words, the shared geographical perspective in the contributions to this book lies in the duality of space as material structure and social construction.

Editing this book has been a long process and I wish to thank all who have contributed to it for their endurance. Special thanks go to Ragnar Löfstedt and four anonymous reviewers for their valuable comments, Sebastian Köllner and Sebastian Scholl for their help in formatting the texts, Michael Wegener for producing the maps, and Ruth Schubert for helping with proofreading and language editing.

Detlef Müller-Mahn, Bayreuth, April 2012

1 Space matters!

Impacts for risk governance

Ortwin Renn and Andreas Klinke

The first chapter of this edited volume conceptualizes the role of space and time in risk governance. The main objective is to integrate spatial dimensions into a systematic approach to organizational and policy learning in assessing, evaluating and managing risks. For this purpose, the risk governance model suggested by the International Risk Governance Council (IRGC) is expanded to include more spatial dimensions at the stages of pre-estimation, interdisciplinary risk estimation, risk characterization and evaluation, risk management, and monitoring and control. This new risk governance model also incorporates expert, stakeholder and public involvement as a core feature at the communication and deliberation stage.

Introduction

Deciding on suitable locations for hazardous facilities, setting standards for chemicals, making decisions about cleaning up contaminated land, regulating food and drugs, or designing and enforcing safety limits all have one element in common: these activities are collective endeavours to understand, assess and handle risks to human health and the environment. These attempts are based on two requirements. First, risk managers need sufficient knowledge about the potential impacts of the risk sources under investigation, and the likely consequences of the different decision options for controlling these risks. Second, they need criteria to judge the desirability or undesirability of these consequences for the people affected and the public at large (Rowe and Frewer 2000; Horlick-Jones *et al.* 2007; Renn and Schweizer 2009). Criteria in respect of desirability are reflections of social values such as good health, equity or efficient use of scarce resources. Both components – knowledge and values – are necessary for any decision-making process independent of the issue and the problem context.

Anticipating the consequences of human actions or events (knowledge) and evaluating the desirability and moral quality of these consequences (values) are the core elements of risk analysis. ‘Crucial for these understandings is the idea that we are living increasingly in a world that changes, not according to what has happened, but according to what is anticipated, i.e. what may happen in the future […]’ (Everts, in this volume). Anticipating future events and judging their desirability poses particular problems if the consequences are complex and uncertain and the values contested and controversial. Dealing with complex, uncertain and ambiguous outcomes often leads to the emergence of social conflict relating to both epistemological as well as moral issues. Questions of how to deal with complex, uncertain and controversial risks demand procedures for dealing with risks that go beyond the conventional risk management routines. Numerous strategies to cope with this challenge have evolved over time. They include technocratic decision-making through the explicit involvement of expert committees, muddling through in a pluralist society, negotiated rule-making via stakeholder involvement, deliberative democracy or ignoring probabilistic information altogether (see reviews in Nelkin and Pollak 1979, 1980; Brooks 1984; Renn 2008: 290ff). The main thesis of this chapter is that risk management institutions need more adequate governance structures and procedures that enable them to integrate professional assessments (systematic knowledge), adequate institutional process (political legitimacy), responsible handling of public resources (efficiency) and public knowledge and perceptions (reflection on public values and preferences). These various inputs are not independent from space and time: they emerge in a specific spatio-temporal context and create, as Zahnen (in this volume) puts it, a feeling of spatio-temporal nestedness. The structures that evolve from the interactions of various actors in all phases of the risk-handling process are again related to spatial and time dimensions.

The way in which actors negotiate and construct 'landscapes' of risk or 'riskscapes' (Müller-Mahn and Everts, Chapter 2 in this volume) is subsumed under the term 'risk governance' (IRGC 2005; Renn 2008: 8). Hutter characterizes the move from governmental regulation to governance in the following manner:

> This decentring of the state involves a move from the public ownership and centralized control to privatized institutions and the encouragement of market competition. It also involves a move to a state reliance on new forms of fragmented regulation, involving the existing specialist regulatory agencies of state but increasingly self-regulating organizations, regimes of enforced self-regulation […] and American-style independent regulatory agencies.
> (Hutter 2006: 215)

'Risk governance' involves the 'translation' of the substance and core principles of governance to the context of risk and risk-related decision-making (Hutter 2006). Based on our previous work on risk governance and risk evaluation (Klinke and Renn 2001, 2002, 2010; Klinke *et al.* 2006; Renn 2008; Renn *et al.* 2011), we will expand in this chapter on the spatial dimensions that underlie or even structure the risk governance process. We adopt a hybrid view on space in this chapter: space is, first, a reference to a physical entity to which humans can relate. This could be a specific landscape or a point on the map. Space in this sense provides an objective anchor for all actors. Second, it refers to a construction of associations that various actors link to space and its dimensions. Space in this sense is a social or mental construct that determines the boundaries of what is seen as inside vs. outside, as reasonable vs. unreasonable or as normal vs. distorted. Space in the

second sense interlinks diverse actors with similar mental models of reality, shapes their claims, structures the institutional means to process diverse inputs and determines to a large degree the individual and social capacity to cope with threats (Bickerstaff and Simmons 2009; see the chapters by Belina and Miggelbrink, Fuchs and Keiler, and Kreutzmann in this volume). Müller-Mahn has suggested a similar distinction between (i) space as principle of order and (ii) space as a projection of social meanings (Müller-Mahn and Everts, Chapter 2 in this volume).

In this chapter we first analyse the major characteristics of risk knowledge, and then address major functions of the risk governance process: pre-estimation, interdisciplinary risk estimation (including scientific risk assessment and concern assessment), risk characterization and risk evaluation, and risk management, including decision-making and implementation. Each of these stages is described in the light of the two meanings of space, drawing on the examples and ideas expressed in this volume. Furthermore, the chapter expands the spatial perspective to design an effective and fair institutional arrangement, including four different forms of public and stakeholder involvement for coping with the challenges raised by the three characteristics of risk knowledge. Finally, the chapter concludes with some general remarks about the relationship between space and risk.

Three characteristics of risk knowledge

Integrative risk governance is expected to address the challenges raised by three risk characteristics that result from a lack of knowledge and/or competing knowledge claims about the risk problem. Transboundary and collectively relevant risk problems, such as global environmental threats (climate change, loss of biological diversity, chemical pollution, etc.), new and/or large-scale technologies (nanotechnology, biotechnology, offshore oil production, etc.), food security or pandemics, are all characterized by limited and sometimes controversial knowledge with respect to their risk properties and their implications (Horlick-Jones and Sime 2004; see Korf in this volume). The three characteristics are complexity, scientific uncertainty and socio-political ambiguity (Klinke and Renn 2002, 2010; Klinke *et al.* 2006; Renn 2008).

Complexity

Complexity refers to the difficulty of identifying and quantifying causal links between a multitude of potential candidates and specific adverse effects (see Lewin 1992; Underdal 2009). A crucial aspect in this regard concerns the applicability of probabilistic risk assessment techniques. If the chain of events between cause and effect follows a linear relationship (as for example in car accidents, or an overdose of pharmaceutical products), simple statistical models are sufficient to calculate the probabilities of harm. But even such simple relationships may be associated with a high degree of uncertainty, for example when very few data are available, or the effect is stochastic by nature. Sophisticated models of probabilistic reasoning are required if the relationship between cause and effect becomes more complex (Renn and Walker 2008). The nature of this difficulty may be traced back to interactive effects among these candidates (synergisms and antagonisms, positive and negative feedback loops), long delay periods between cause and effect, inter-individual variation, intervening variables, and others. It is precisely these complexities that make sophisticated scientific investigations necessary, since the cause–effect relationship is neither obvious nor directly observable.

At first glance, complexity seems to be a universal and abstract term that is not related to time and location. However, all causal knowledge requires a concept of temporal sequence (A leads to B) as well as a concrete place where cause and consequence can be physically located. Non-linear response functions often result from interactions that depend on the spatial context in which they occur. Complexity therefore requires sensitivity to temporal and spatial factors relating to scale, as well as to the presence of intervening factors within the space in which the risk occurs. Space also refers to a multitude of exposure pathways and the composite effects of other agents that are present in the spatio-temporal context modelled by the scientists. Examples of highly complex risk include the diffusion of chemicals in air and water, synergistic effects of potentially eco-toxic substances on the environment, failure risk of large interconnected infrastructures and risks relating to critical loads in sensitive ecosystems. All of these examples require a spatial analysis as part of the process of knowledge acquisition in respect of impending risks.

Scientific uncertainty

Scientific uncertainty relates to the limitedness or even absence of scientific knowledge (data, information) that makes it difficult to exactly assess the probability and possible outcomes of undesired effects (see Rosa 1997; Aven and Renn 2009; Filar and Haurie 2010). It most often results from an incomplete or inadequate reduction of complexity in modelling cause–effect chains (see Marti *et al.* 2010). Whether the world is inherently uncertain is a philosophical question that is not pursued here. It is essential to acknowledge in the context of risk assessment that human knowledge is always incomplete and selective, and, thus, contingent upon uncertain assumptions, assertions and predictions (Functowicz and Ravetz 1992; Laudan 1996; Renn 2008: 75). It is obvious that the modelled probability distributions within a numerical relational system can only represent an approximation of the empirical relational system that helps elucidate and predict uncertain events. It therefore seems prudent to include additional aspects of uncertainty (van Asselt 2000: 93–138). Although there is no consensus in the literature on the best means of disaggregating uncertainties, the following categories appear to be an appropriate means of distinguishing between the key components of uncertainty:

- *Variability* refers to different vulnerability of targets such as the divergence of individual responses to identical stimuli among individual targets within a relevant population such as humans, animals, plants, landscapes, etc.

- *Inferential effects* relate to systematic and random errors in modelling including problems of projecting inferences from small statistical samples, from animal data or experimental data onto humans or from large doses to small doses, etc. All of these are usually expressed as statistical confidence intervals.
- *Indeterminacy* results from a genuine stochastic relationship between cause and effects, apparently non-causal or non-cyclical random events, or badly understood non-linear, chaotic relationships.
- *System boundaries* allude to uncertainties stemming from restricted models and the need for focusing on a limited number of variables and parameters.
- *Ignorance* means a lack of knowledge about the probability of occurrence of a damaging event and about its possible consequences.

The first two components of uncertainty qualify as statistically quantifiable uncertainty and can be reduced by improving existing knowledge, applying standard statistical instruments such as Monte Carlo simulation and estimating random errors within an empirically proven distribution. They include the spatio-temporal component in the first, physical sense. Space and time structure the analysis for characterizing and ideally calculating uncertainties. The last three components represent genuine uncertainty components and can be characterized to some extent by using scientific approaches, but cannot be completely resolved. This is the domain for spatial dimensions of the second kind: they mark boundaries between what humans believe ‘could happen to them’, what stakeholders claim as being significant or insignificant and what individuals feel as a justified cause for being concerned or not (Everts, in this volume). The validity of such uncertainty considerations (or ‘bethinking’ as Zahnen has phrased it in this volume) depends on the shared meaning of spatio-temporal experiences. Risk assessment and management agencies require additional information and input, such as a subjective confidence level in risk estimates, potential alternative pathways of cause–effect relationships, ranges of reasonable estimates, maximum loss scenarios and others. Examples of high uncertainty include many natural disasters, such as earthquakes, possible health effects of pandemics and long-term effects of introducing genetically modified species into the natural environment.

Socio-political ambiguity

While more and better data and information may reduce scientific uncertainty and cause a gradual overlapping of the two concepts of space, more knowledge does not necessarily reduce ambiguity. Ambiguity thus indicates a situation of ambivalence in which different and sometimes divergent streams of thinking and interpretation about the same risk phenomena and their circumstances are apparent (see Feldman 1989; Zahariadis 2003). We distinguish between interpretative and normative ambiguity which both relate to divergent or contested views regarding the justification, severity or wider ‘meanings’ associated with a given threat (Stirling 2003; Renn 2008: 77). Entering the realm of ambiguity opens the dimensions of space towards a whole set of subjective interpretations and meanings. This range is often associated with a different understanding of spatial and temporal dimensions. For example, Kreutzmann (in this volume) explores the meaning of boundaries in risk perception and conflict assessment, while Everts (in this volume) demonstrates that distance has a variety of meanings when applied to the threat of pandemics.

Interpretative ambiguity denotes the variability of (legitimate) interpretations based on identical observations or data assessment results, e.g. an adverse or non-adverse effect. Variability of interpretation, however, is not restricted to expert dissent. Lay people's perception of risk often differs from expert judgements because it is related to qualitative risk characteristics such as familiarity, personal or institutional control, assignment of blame, and others. Moreover, in contemporary pluralist societies diversity of risk perspectives within and between social groups is generally fostered by divergent experiences of space and location. Some people view themselves as world citizens who extend their concerns to all areas of the world; others expand their home space to all people who have similar life experiences or worldviews. They may care for all people who live in Catholic communities or who have been victims of car accidents. The virtualization of space has widely expanded the number and structure of options that demarcate the line between us (home space) and the others (foreigners or intruders). One interesting example of high interpretative ambiguity is concern about the impact of alien species on natural environments. Crucial questions are: is home defined by physical locality or familiarity? Have alien species a right to move to places that provide better living conditions even if they reduce the species that already inhabit the respective eco-space? How far should I go back in time to determine which species is alien and which domestic?

This leads us to the aspect of *normative ambiguity*. It alludes to different concepts of what can be regarded as tolerable, referring for instance to ethics, quality of life parameters, distribution of risks and benefits, etc. Ambiguity emerges where the problem is agreeing on the appropriate values, priorities, assumptions or boundaries to be applied to the definition of possible outcomes. Normative ambiguities can be associated, for example, with exposure to noise, aquaculture in sensitive areas, pre-natal genetic screening or genetically modified food. As Belina and Miggelbrink point out (in this volume), tolerability and acceptability are not properties of a risk object but products of power and social attribution. Appropriation of space is a means used by powerful actors to influence social judgements about what is tolerable and what is not. A good example of this is the use of phthalates in toys. All analysts are aware that this substance is potentially carcinogenic, but given the known exposure and the dose–response functions there is hardly any possibility of young children being negatively affected (Wilkinson and Lamb 1999). Yet the mere idea of having a carcinogenic substance in children's toys (home territory) has incited a fierce debate about the tolerability of such an ingredient in rubber toys.

Most risks are characterized by a mixture of complexity, uncertainty and ambiguity. Passive smoking may be a good example of low complexity and uncertainty, but high ambiguity. Nuclear energy may be a good candidate for high complexity and high ambiguity, but relatively little uncertainty. The massive emission of aerosols into the atmosphere to combat the effects of greenhouse gases might be cited as an example of high complexity, uncertainty and ambiguity.

Towards an inclusive risk governance model

The ability of risk governance institutions to cope with complex, uncertain and ambiguous consequences and implications has become a central concern of scientists and practitioners alike. In 2005, the International Risk Governance Council suggested a process model of risk governance (IRGC 2005; Renn 2008). This framework structures the risk governance process in four phases: pre-assessment, appraisal, characterization and evaluation, and risk management. Communication is conceptualized as a constant companion to all four phases of the risk governance cycle. The framework's risk process, or risk-handling chain, is illustrated in Figure 1.1.

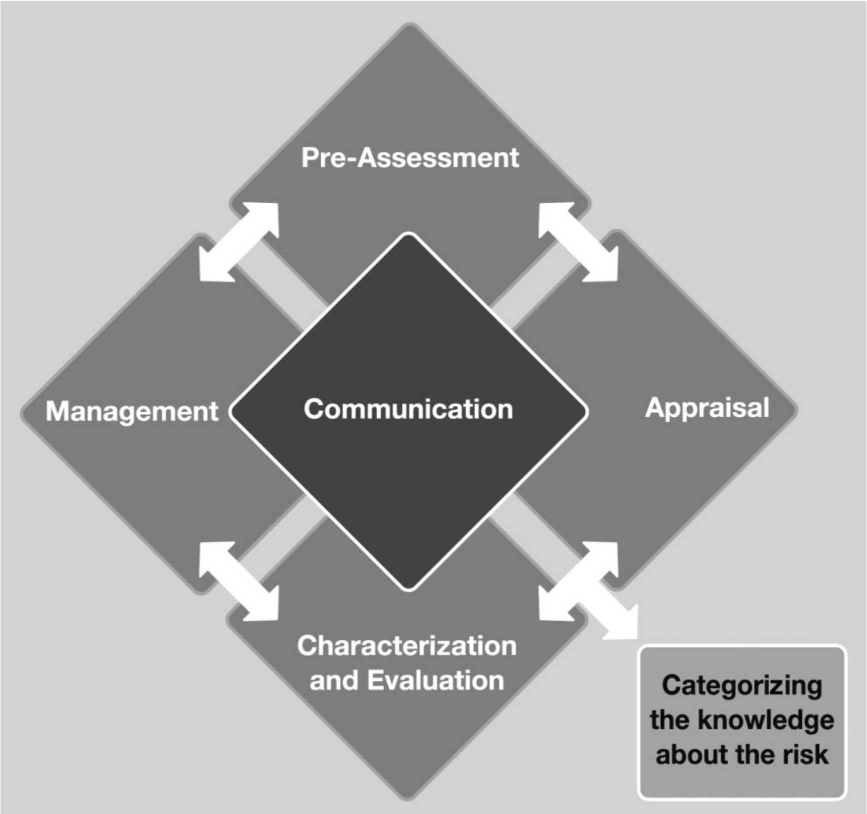

Figure 1.1 The Risk Governance Framework

Since its publication in 2005, the IRGC Risk Governance Framework has been applied to diverse risk governance issues in various case studies. Publications of these case studies are available on IRGC's homepage (www.irgc.org/publications.html). The case studies deal with emerging risks such as air quality, bioenergy, carbon capture and storage, critical infrastructure, nanotechnology, pollination services and synthetic biology. Furthermore, the IRGC has commissioned several case studies as tests of the applicability, efficacy and practicability of the Risk Governance Framework (Renn and Walker 2008). The applications have shown that the framework can be used as broad conceptual guidance on the critical elements of the risk governance process. To date, the IRGC risk framework has been discussed and partially applied to a number of institutions and organizations, including most prominently the European Food Safety Authority (Vos and Wendler 2009) and the Health Council of the Netherlands (2006). Reports using the framework have been given by the German Occupational Health and Safety Committee (Bender 2008), the International Occupational Safety Association (Radandt *et al.* 2008), the UK Treasury (HM Treasury 2005a), the US Environmental Protection Agency (US-EPA 2009) and several private organizations. In addition, the framework was applied to strategic risk management by the US Joint Chiefs of Staff (Rouse 2011). The model has been used for major military operations and has, according to the source, improved the risk management process considerably.

The framework was primarily developed to deal with technological risks. It has been criticized as overstating the demarcation line between assessment and management, as being too rigid in its phasing of the governance process and in being not specific enough on stakeholder involvement and participation (see articles in Renn and Walker 2008; van Asselt 2005). For the purpose of developing a more adaptive and inclusive version of the IRGC framework, Klinke and Renn (2012) and Renn *et al.* (2011) suggest a slightly modified version as illustrated in Figure 1.2.

The modified framework consists of the steps: pre-estimation, interdisciplinary risk estimation, risk characterization, risk evaluation and risk management. This is all related to the ability and capacity of risk governance institutions to use resources effectively (see Figure 1.2). Appropriate resources include institutional and financial means as well as social capital (e.g. strong institutional mechanisms and configurations, transparent decision-making, allocation of decision-making authority, formal and informal networks that promote collective risk handling, education), technical resources (e.g. databases, computer software and hardware) and human resources (e.g. skills, knowledge, expertise, epistemic communities). Hence, the adequate involvement of experts, stakeholders and the public in the risk governance process is a crucial dimension to produce and convey adaptive and integrative capacity in risk governance institutions (see Pelling *et al.* 2008). The revised framework by Klinke and Renn does not address spatial aspects in any detail. The following sections will explore the significance of spatial dimensions for each stage of the risk governance process.

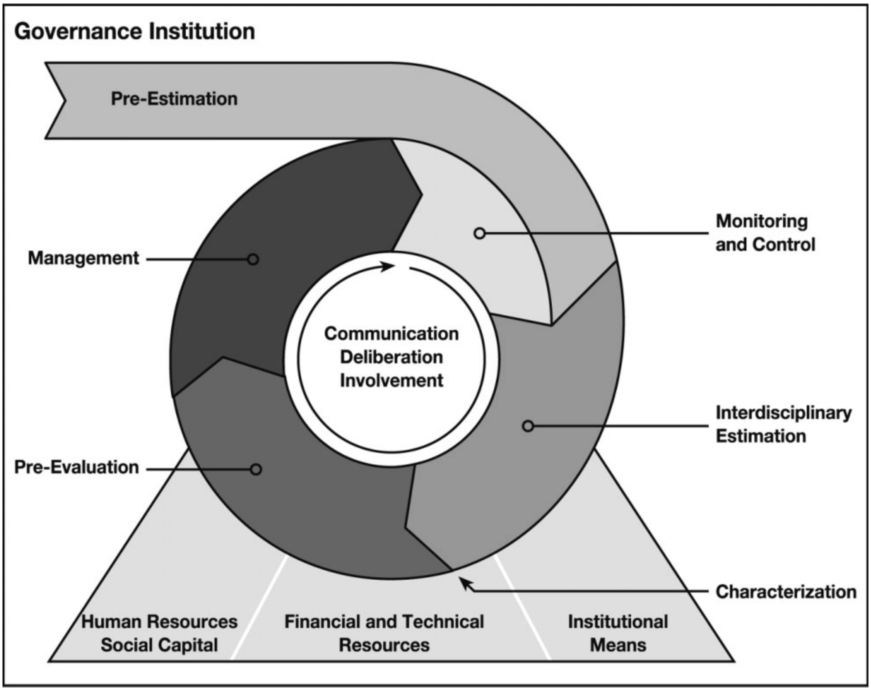

Figure 1.2 Adaptive and integrative risk governance model

Pre-estimation

Risks are not straightforwardly objective phenomena. They are based on the observation of hazards, i.e. the inherent potential for causing harm. Kreutzmann (in this volume) refers to this understanding of risk as representing the first level of analysis, i.e. potentiality of contingent changes in system behaviour. His third level of analysis refers to potentiality according to the contingency of ways of defining, dealing with or being involved in this potentiality of harmfulness. This corresponds in our analysis to the conception that risks are also mental constructions that reflect how people perceive uncertain phenomena and the ways in which their interpretations and responses are determined by social, political, economic and cultural contexts and judgements (see Luhmann 1993; OECD 2003; IRGC 2005). In this sense, both risks and space have an objective and a subjective component (see Weichhart and Höferl in this volume).

The introduction of risk as a mental construct is contingent on the presumption that human action can prevent harm in advance. The conceptualization of risk as a mental construct has major implications for how risk is considered. Risks are created and selected by human actors. What counts as a risk for one person may be seen by another as a destiny explained by religion, or even as an opportunity by a third party. Although societies have over time gained experience and collective knowledge of the potential impacts of events and activities, one cannot anticipate all potential scenarios and be worried about all the many potential consequences of a proposed activity or an expected event. By the same token, it is impossible to include all possible options for intervention. Therefore, societies have been *selective* in what they have chosen to consider worth addressing and what to ignore. One of the most significant selection rules is related to space and time. Any risk source that threatens our space and will happen in our time will gain more attention than a risk that seems to be far away or a long way ahead. Pohl *et al.* (in this volume) provide telling examples of how the media create proximity or timeliness and thus construct (often virtual) home spaces on the basis of perceived familiarity or plausibility. The same phenomenon is reported in the case study of swine flu by Everts (in this volume): proximity and time presence was orchestrated by narratives linking globalized markets with the diffusion of viruses and bacteria.

It is important to explore what major political and societal actors such as governments, companies, epistemic communities, non-governmental organizations and the general public identify as risks and what types of problems they label as problems associated with risk and uncertainty. This is called *framing* and it specifies how society and politics rely on schemes of selection and interpretation to understand and respond to those phenomena which are socially constructed as relevant risk topics (Kahneman and Tversky 2000; Reese *et al.* 2003). Interpretations of risk experience depend on the frames of reference (Daft and Weick 1984). The process of framing corresponds to images of space and time. Pohl *et al.* (in this volume) emphasize that the codes of different social systems include representations of space. These representations shape specific concepts of risks and dangers. Stakeholders with narrow space definitions are often more risk prone than those who prefer wider concepts of space, thus acknowledging more uncertainty and ambiguity. For example, Merad *et al.* (2008) were able to prove that managers of hazardous sites were more often convinced that stringent risk management actions were necessary the more they felt that a disaster could affect people outside of the disaster zone. Conversely, those who held the conviction that accidents in their facilities could only affect people living directly in the neighbourhood had little doubt that the risk assessment numbers were correct and reliable. Another issue is variety among the actors. What counts as a serious risk may vary among different actor groups. Whether an overlapping consensus evolves about what requires consideration as a relevant risk depends on the legitimacy of the selection rule. For example, the risks and benefits of biomass conversion for energy purposes can be seen under the frame of energy security, national independence, climate protection or economic development opportunities for rural areas. Depending on the frame, different types of risks and benefits may emerge; furthermore some benefits under one frame (for example national independence) may be a risk for another frame (economic opportunities for developing countries). One should note that all these frames make explicit reference to space: in particular, the frame of national independence (not dependent on energy imports) as well as the development frame (opportunity for local farmers to co-produce food and energy) rely on a definition of what space is considered relevant and significant for policy-making.