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Risk governance: Application to urban planning[1]

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Abstract:
Urban planning faces multiple risks: they range from natural disasters, fires, floods, building code violations to social risks such as vandalism, crime, social disorientation, and others. These risks often interact with each other and cannot be dealt with in isolation. As a means to identify, assess and manage multiple risks, concepts of "risk governance" have been developed that promise to provide integrative and comprehensive tools to deal with urban risks. The notion of risk governance pertains to the many ways in which multiple actors, individuals and institutions, public and private, deal with risks. It includes formal institutions and regimes and informal arrangements. The paper will first develop an adaptive and integrative model of risk governance and applies this model to the risks of urban planning. After a short summary of the roots of risk governance, key concepts, such as "simple, uncertain, complex and ambiguous risks will be discussed. The main emphasis will be on each of the five phases of risk governance: pre-assessment, interdisciplinary assessment, risk evaluation; risk management and risk communication.

Keywords: *Risk governance, urban planning, city planning, risk management, risk assessment, risk perception, risk evaluation, complexity, uncertainty, ambiguity.*

1. Introduction

Risk governance denotes both the institutional structure and the policy process that guide and restrain collective activities of a group, society or international community to regulate, reduce or control risk problems (Klinke and Renn, 2012). We can observe that the contemporary handling of collectively relevant risk problems has been shifted away from traditional state-centric approaches with hierarchically organized governmental agencies to separately constituted public bodies with overlapping jurisdictions that do not match the traditional hierarchical order (cf. Skelcher, 2005; Hooghe and Marks, 2003). This implicates an increasingly multilayered and diversified socio-political landscape, in which a multitude of actors, their perceptions and evaluations draw on a diversity of knowledge and evidence claims, value commitments and political interests in order to influence processes of risk analysis, decision-making and risk management

(Jasanoff, 2004). Institutional diversity can offer considerable advantages:

- First, risk problems that affect different urban spaces at the same time can be managed in accordance with each unique set of spatial conditions (specificity);
- Second, an inherent degree of overlap and redundancy makes non-hierarchical adaptive and integrative risk governance systems more resilient and therefore less vulnerable, and
- Third, the larger number of actors facilitates experimentation and learning (Renn, 2008: 177ff.).

Disadvantages refer to the possible commodification of risk; the fragmentation of the risk governance process; costly collective risk decision-making; and the potential loss of democratic accountability (Charnley, 2000). Thus, understanding the dynamics, structures and functionality of risk governance processes requires a general and comprehensive conceptualization of procedural mechanisms and structural configurations. The classic model of risk analysis consisting of three components: risk assessment, management and communication proves to be too narrowly focused on regulatory bodies as to be capable of covering the variety of actors and processes in governing risk. Therefore it is necessary to enrich the classic model by adding two additional steps called risk evaluation and pre-estimation (IRGC 2005). These steps will be explained later in the paper. Furthermore, risk governance incorporates expert, stakeholder and public involvement as a core feature in the stage of communication and deliberation.

Based on our previous work on risk governance and risk evaluation (Klinke and Renn, 2002; 2012; Renn, 2008; Renn et al., 2011; Renn and Klinke, 2013), we will first outline three major characteristics of risk that pose specific challenges for risk governance and entail particular forms of involvement of actor groups. Subsequently, we 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 as well as risk management including decision-making and implementation. Furthermore, we will explicate the design of an effective and fair institutional arrangement including four different forms of public and stakeholder involvement in order to cope with the challenges raised by complexity, uncertainty, and ambiguity. These basic insights will then be applied to urban planning and evaluation. Finally, the article concludes by introducing a governance decision tree that allows a systematic step-by-step procedure for a more inclusive risk governance process.

2. Three characteristics of risk knowledge

Adaptive and integrative governance on risk is supposed to address challenges raised by three risk characteristics that result from a lack of knowledge and/or competing knowledge claims about the risk problem. The three characteristics are complexity, scientific uncertainty and socio-political ambiguity (Klinke and Renn, 2002, 2010; Renn et al., 2011).

2.1 Complexity

Complexity refers to the difficulty of identifying and quantifying causal links between a multitude of potential candidates and specific adverse effects (cf.: Underdal, 2009; Waldrop, 1992). A crucial aspect in this respect concerns the applicability of probabilistic risk assessment techniques. If the chain of

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events between a cause and an effect follows a linear relationship (as for example in car accidents, or in a collapse of a building due to inadequate building material), simple statistical models are sufficient to calculate the probabilities of harm. Such simple relationships may still be associated with high uncertainty, for example, if only few data are available or the effect is stochastic by its own nature (for example an earthquake). Sophisticated models of probabilistic inferences are required if the relationship between cause and effects becomes more complex (Renn and Walker, 2008a). 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. Complexity requires sensitivity to non-linear transitions as well as to scale (on different levels). Examples of highly complex risk include sophisticated chemical facilities that may threaten nearby settlements, synergistic effects of potentially toxic substances in urban air, failure risk of large interconnected infrastructures such as water and electricity grits and risks of critical loads to sensitive ecosystems within human settlements.

2.2 Scientific uncertainty

Scientific uncertainty may result form unresolved complexity, in particular if the cause-effect models show large confidence intervals (Marti et al. 2010). It relates to the limitedness or even absence of scientific proof for a causal or functional relationship that makes it difficult to exactly assess the probability and possible outcomes of undesired effects (cf.: Aven and Renn, 2009; Filar and Haurie, 2010). 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: 75ff.). It is obvious that the modeled 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). Examples of high uncertainty include many natural disasters, such as earthquakes, possible health effects of airborne pollutants below the threshold of statistical significance, acts of violence - such as terrorism and sabotage - and long-term effects of high social mobility on personal wellbeing and social cohesion.

2.3 Socio-political ambiguity

While more and better data and information may reduce scientific uncertainty, 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 (cf. Feldman, 1989; Zahariadis, 2003). We distinguish between interpretative and normative ambiguity which both relate to divergent or contested perspectives on the justification, severity or wider ‘meanings’ associated with a given threat (Stirling, 2003; Renn, 2008: 77).

Interpretative ambiguity denotes the variability of (legitimate) interpretations based on identical observations or data assessments results, e.g. an adverse or non-adverse effect. Variability of interpretation, however, is not

restricted to expert dissent. Laypeople's perception of risk often differs from expert judgments 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 value preferences, variations in interests and very few, if any universally applicable moral principles; all the more, if risk problems are complex and uncertain.

That leads us to the aspect of *normative ambiguity*. It alludes to different concepts of what can be regarded as tolerable referring e.g. to ethics, quality of life parameters, distribution of risks and benefits, etc. A condition of ambiguity emerges where the problem lies in agreeing on the appropriate values, priorities, assumptions, or boundaries to be applied to the definition of possible outcomes. Examples for high interpretative ambiguity include exposure to low dose radiation (ionizing and non-ionizing), low concentrations of genotoxic substances, food supplements and, in the social domain, the gentrification of urban quarters. Normative ambiguities can be associated, for example, with passive smoking, restricted mobility regimes in highly congested cities (such as city maut), zoning laws for hazard-prone areas or busing of schoolchildren from different social classes.

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 use of IT in smart city governance systems could be cited as an example for high complexity, uncertainty and ambiguity.

3. Adaptive and integrative capacity of risk governance

The ability of risk governance institutions to cope with complex, uncertain and ambiguous consequences and implications has become a central concern to scientists and practitioners alike. We understand adaptive and integrative governance on risk broadly as the ability of politics and society to collectively design and implement a systematic approach to organizational and policy learning in institutional settings that are conducive to resolving complexity, uncertainty and ambiguity in risk arenas.[2]

[2] To the definition and understanding of adaptive capacity, see e.g. Armitage et al. (2007), Berkhout et al. (2006) and Webster (2009).

It is a dynamic governance process of continuous and gradual learning and adjustment. Adaptive and integrative capacity in risk governance processes encompasses a broad array of structural and procedural mechanisms by which politics and society can handle collectively relevant risk problems. In practical terms, adaptive and integrative capacity is the ability to design and incorporate the necessary steps in a risk governance process that allow risk managers to reduce, mitigate or control the occurrence of harmful outcomes resulting from collectively relevant risk problems in an effective, efficient and fair manner (cf. Brooks and Adger, 2005).

Adaptive and integrative governance on risk and uncertainty requires a set of resources available for accomplishing the tasks associated with the prudent handling of complexity, uncertainty and ambiguity. In 2005, the International Risk Governance Council suggested a process model of risk governance based on the work of the authors (IRGC 2005; Klinke and Renn, 2012; Renn 2008; Renn and Walker, 2008a). This framework structures the

risk governance process in four phases: pre-assessment, appraisal, characterization and evaluation, and risk management. Communication and stakeholder involvement were conceptualized as constant companions to all four phases of the risk governance cycle. Based on this framework and informed by many comments on the original framework (for example the edited volume by Renn and Walker, 2008b), we modified the original IRGC proposal. The new framework suggested here in this paper 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).

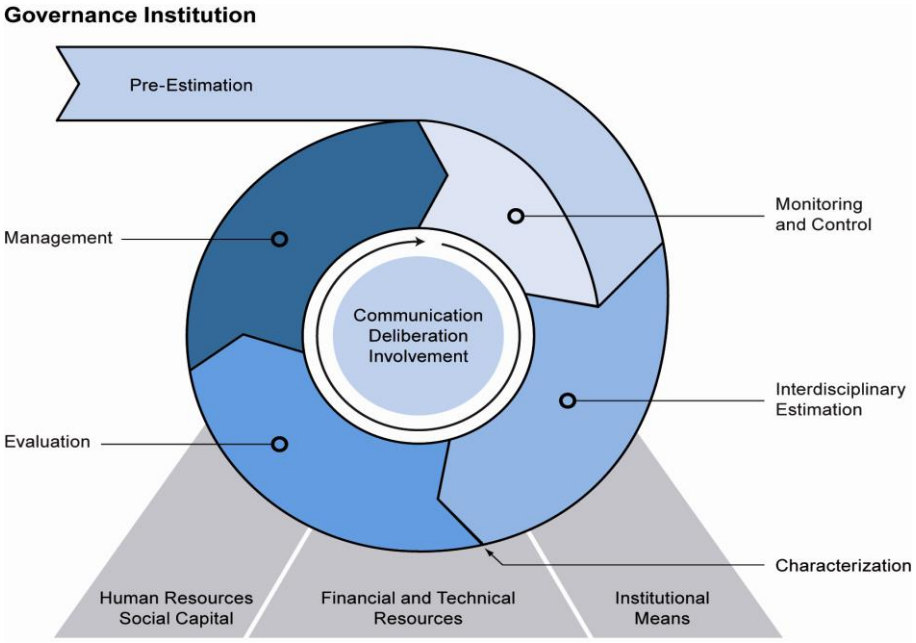

Figure 1. *Adaptive and integrative risk governance model (adapted from Klinke and Renn, 2012).*

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 soft- and hardware etc.), and human resources (e.g. skills, knowledge, expertise, epistemic communities etc.). 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 (cf. Pelling et al., 2008).

4. Pre-Estimation

A systematic review of the stages in pre-estimation would start with screening as an exploration of a large array of actions and problems looking for those with a specific risk-related feature. It is important to explore what major political and societal actors such as e.g. governments, companies, epistemic communities, nongovernmental organizations and the general public identifies 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 what is socially constructed as relevant risk topics (Kahneman and Tversky, 2000; Nelson et al., 1997; Reese et al., 2003). Interpretations of risk experience depend on the frames of reference (Daft and Weick, 1984). The process of framing corresponds with a multi-actor and multi-objective governance structure since governmental authorities (national, supranational and international agencies), risk and opportunity producers (e.g. industry), those affected by risks and opportunities (e.g. consumer organizations, environmental groups) and interested bystanders (e.g. the media or an intellectual elite) are all involved and often in conflict with each other about the appropriate frame to conceptualize the problem. What counts as risk may vary among these actor groups. Whether an overlapping consensus evolves about what requires consideration as a relevant risk depends on the legitimacy of the selection rule.

How does this phase of pre-estimation relate to urban planning? In this phase it is essential to familiarize oneself with the various risk concepts and images that are part of the early planning process. Architects, builders, urban planners, industrial contractors, real estate agents and last not least the affected population all have different expectations and concerns that should be addressed before an actual plan is worked out. The idea is to collect these different concepts and make them an integral part of the urban renewal or development plan. The best instrument for implementing such an input is by interviewing key people in the process of developing the plan and to conduct a survey among residents about their preferences and concerns (Renn, 2008: 340ff.). In addition, it might be advisable to establish a Round Table in which different concepts are discussed and a consensus reached about the main goals and required steps to reach them.

5. Interdisciplinary risk estimation

The interdisciplinary risk estimation comprises two stages (cf.: IRGC 2005; Renn and Walker, 2008a):

> (1) *Risk assessment:* experts of natural and technical sciences produce the best estimate of the physical harm that a risk source may induce; such harm could be the collapse of buildings, discontinuation of central services to residents such as water, electricity or information, breakdown of traffic, inadequacy of infrastructural support.
> (2) *Concern assessment:* experts of social sciences including economics identify and analyze the issues that individuals or society as a whole link to a certain risk. Here dysfunctional social services, risks of economic subsistence but also risks based on perceptions of crime or insecurity belong to this portfolio. For identifying and exploring these risks, the repertoire of the social sciences such as survey methods, focus groups, econometric analysis, macro-economic modeling, or structured hearings with stakeholders may be used.

In reference to urban planning, the phase of interdisciplinary estimation includes two consecutive steps: First it is mandatory to assess each risk that one faces in the development of new urban districts. These risks can refer to exposure to natural hazards, technical failures, infrastructure failure or inefficiency, planning mistakes, inadequate building codes and inadequate

consideration of social needs and preferences. These risks are very different in nature and require specific techniques for addressing them. However, they all have in common that they include a hazard assessment (what is the potential harm?), an exposure assessment (who and what might be affected), a vulnerability analysis (what harm or damage can be expected for whom and to what degree?) and finally a quantitative or at least qualitative risk estimate which combines the hazards, exposure and vulnerability assessments to an overall risk profile. Once these profiles have been constructed it is very important to understand the connections between these risks. Some minor risk in one part can augment or amplify risks in another area (Burns et al. 1993). Formally such integration can be performed by using influence diagrams or Petri nets.

The second step in risk estimation is the inclusion of the concerns and expectations by those involved in the urban planning process. The main idea is here to collect the necessary knowledge by stakeholders and affected citizens about their preferences in terms of risk reduction and risk handling. This step is often forgotten but is essential for matching the physical risk assessments with human perception (van Asselt and Renn, 2011). Among the instruments to perform such a concern assessment one would suggest Group Delphi processes or hearings (Renn, 2008: 336ff.).

6. Risk evaluation

A heavily disputed task in the risk governance process relates to the procedure of how to classify a given risk and justify an evaluation about its societal acceptability or tolerability (see Figure 2). In many approaches, risks are ranked and prioritized based on a combination of probability (how likely is it that the risk will occur) and impact (what are the consequences, if the risk does occur). In the so-called traffic light model, risks are located in the diagram of probability versus expected consequences and three areas are identified: green, amber and red (Klinke and Renn, 2002; Renn, 2008: 149ff.).

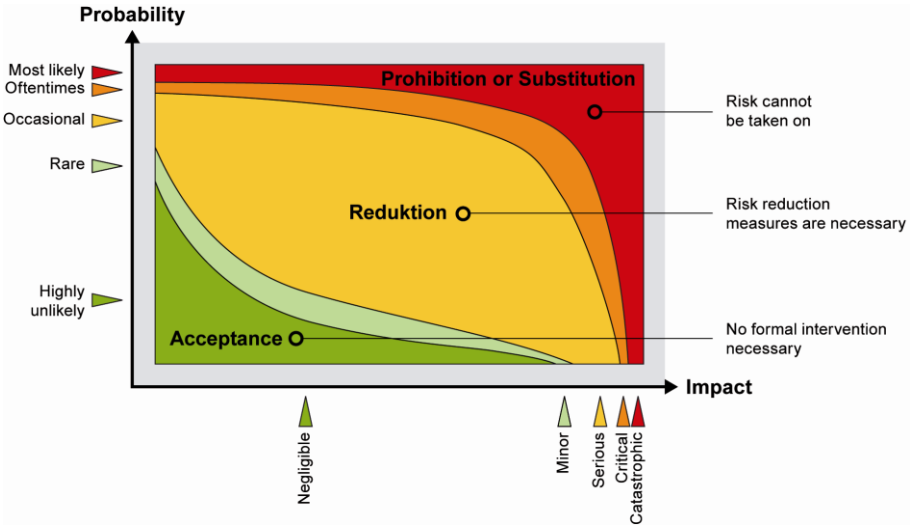

Figure 2. *Risk areas adopted from Klinke and Renn, 2012.*

A risk falls into the green area if the occurrence is highly unlikely and the impact is negligible. No further formal intervention is necessary. A risk is

seen as tolerable when serious impacts might occur occasionally (amber area). The benefits are worth the risk, but risk reduction measures are necessary. Finally, a risk is viewed as intolerable when the occurrence of catastrophic impacts is most likely (red area). Possible negative consequences of the risk are so catastrophic that in spite of potential benefits it cannot be tolerated.

To draw the lines between 'acceptable' (green area), 'tolerable' (yellow area) and 'intolerable' (red area) is one of the most controversial tasks in the risk governance process. The UK Health and Safety Executive developed a procedure for chemical risks based on risk-risk comparisons (Löfstedt, 1997). Some Swiss cantons such as Basle County experimented with Round Tables as a means to reach consensus on drawing the two demarcation lines, whereby participants in the Round Table represented industry, administrators, county officials, environmentalists, and neighborhood groups. Irrespective of the selected means to support this task, the judgment on acceptability or tolerability is contingent on making use of a variety of different knowledge sources. One needs to include the data and insights resulting from the risk assessment activity, and additional data from the concern assessment.

In the context of urban planning, it is important to have different urban development plans or options available and compare these options from both sides: the opportunities including potential revenues and the risks, including financial costs and liabilities. It is recommended to use either multi-criteria or multi-attribute decision analytic models to identify potential conflicts between objectives and criteria and to assign tradeoffs between these conflicting objectives (Keeney, 1992; Keeney and McDaniels, 2002). Stakeholders and representatives of the public should be asked to assist in determining relative weights and thus reflecting plural value input (Arvai et al., 2001; Hagendijk and Irwin, 2006).

7. Risk management

Risk management starts reviewing all relevant data and information generated in the previous steps of interdisciplinary risk estimation, characterization and risk evaluation. The systematic analysis of risk management options focuses on still tolerable risks (amber area) and those where tolerability is disputed (light green and orange transition zones). The other cases (green and red area) are fairly easy to deal with. Intolerable risks demand prevention and prohibition strategies as a means of replacing the hazardous activity with another activity leading to identical or similar benefits. The management of acceptable risks is left to private actors (civil society and economy). They may initiate additional and voluntary risk reduction measures or to seek insurance for covering possible but rather minor or negligible losses. If risks are classified as tolerable, or if there is a dispute as to whether they are in the transition zones of tolerability, public risk management needs to design and implement actions that make these risks either acceptable or at least tolerable by introducing reduction strategies. Based on the distinction in complexity, scientific uncertainty and socio-political ambiguity, it is possible to design general strategies for risk management that can be applied to four distinct categories of risk problems, thus simplifying the process of risk management (Klinke and Renn, 2002).

The first category refers to linear risk problems: they are characterized as having low scores on the dimensions of complexity, uncertainty and

ambiguity. They can be addressed by *linear risk management* because they are normally easy to assess and quantify. Routine risk handling within risk assessment agencies and regulatory institutions is appropriate for this category, since the risk problems are well known, sufficient knowledge of key parameters is available and there are no major controversies about causes and effects or conflicting values. The management includes risk-benefit analysis, risk-risk comparisons or other instruments of balancing pros and cons.

If risks are ranked high on complexity but rather low on uncertainty (i.e. the complexity can be widely resolved by adequate scientific models) and ambiguity, they require a systematic involvement and deliberation of experts representing the relevant epistemic communities for producing the most accurate estimate of the complex relationships. It does not make much sense to integrate public concerns, perceptions or any other social aspects for resolving complexity unless specific knowledge from the concern assessment helps to untangle complexity. Complex risk problems therefore demand *risk-informed management* that can be offered by scientists and experts applying methods of expanded risk assessment, determining quantitative safety goals, consistently using cost-effectiveness methods, and monitoring and evaluating outcomes.

Risk problems that are characterized by high uncertainty but low ambiguity require *precaution-based management.* Since sufficient scientific certainty is currently either not available or unattainable, expanded knowledge acquisition may help to reduce uncertainty and, thus, move the risk problem back to first stage of handling complexity. If, however, uncertainty cannot be reduced by additional knowledge, risk management should foster and enhance precautionary and resilience-building strategies and decrease vulnerabilities in order to avoid irreversible effects. Appropriate instruments include containment, diversification, monitoring and substitution. Because the focal point here is to find the adequate and fair balance between being overcautious versus being not cautious enough, a reflective processing involving stakeholders is necessary to ponder concerns, economic budgeting and social evaluations.

Finally, if risk problems are ranked high on ambiguity (regardless of whether they are low or high on uncertainty), *discourse-based management* is required demanding participative processing. This includes the need to involve major stakeholders as well as the affected public. The goals of risk management is to produce a collective understanding among all stakeholders and concerned public on interpretative ambiguity or to find legitimate procedures of justifying collectively binding decisions on acceptability and tolerability. It is important that a consensus or a compromise is achieved between those who believe that the risk is worth taking (perhaps because of self-interest) and those who believe that the pending consequences do not justify the potential benefits of the risky activity or technology.

Applying these risk management regimes to urban planning, one can envision the following idealized risk management process: At the beginning of the risk management process it is required to design and assess different risk reduction measures. Once the most promising option for urban development or renewal is chosen the risk profile will show potential opportunities but also deficits in terms of risks or concerns. This is now the

phase in which risk reduction options are generated, discussed and selected. Depending on the degree of complexity, uncertainty and ambiguity, one should choose risk reduction options that relate to best available technical knowledge (high complexity), emphasize reversibility and robustness (high uncertainty) and include participatory instruments in case of high ambiguity (Renn et al., 2011). If the risk reduction program is controversial or includes value conflicts instruments such as citizen panels or citizen advisory groups would be highly recommended (Rowe and Frewer, 2000).

8. Risk communication

All four phases need to be accompanied by intensive risk communication efforts. These efforts should start during the pre-estimation phase. It should convey the basic concepts and what these concepts entail in terms of opportunities and risks. Feedback channels can be arranged on the Internet as a means to scan the responses by stakeholders and affected citizens. During the risk estimation phase the communication process should emphasize the process by which the research and planning team conducts the risk assessments. The main goal here is to promote trust in the risk handling authorities (Löfstedt, 2005).

It might be helpful to ask stakeholders and citizens for additional knowledge that the public officials may not have. More input from the public is encouraged during the evaluation phase. First of all, the process of how tradeoffs are assigned and justified needs to be made transparent to all stakeholders as well as the general public. Furthermore depending on the degree of ambiguity it might be useful to have procedures in place that systematically collect feedback and concerns with respect to the planned urban renewal or development options. During the management phase it is essential to familiarize all affected persons with the chosen or deliberated risk reduction measures, in particular those that rely on cooperation of the affected public (such as evacuation or sheltering plans). Instruments for making risk reduction plans known to the public are open meetings, brochures, websites, TV shows and other popular forms of information transfer (Earle and Cvetkovich, 1994).

9. Inclusive governance: The need for a gradual inclusion of experts, stakeholders and civil society

The effectiveness and legitimacy of the risk governance process depends on the capability of the management agencies to resolve complexity, characterize uncertainty and handle ambiguity by means of communication and deliberation. In the following, we differentiate particular procedural mechanisms of communication and deliberation to address each of the specific challenges raised by complexity, scientific uncertainty and socio-political ambiguity.

9.1 Instrumental processing involving governmental actors

Dealing with linear risk issues, which are associated with low scores of complexity, scientific uncertainty and socio-political ambiguity, requires hardly any changes to conventional public policymaking. The data and information of such linear (routine) risk problems are provided by statistical analysis, law or statutory requirements determine the general and specific objectives, and the role of public policy is to ensure that all necessary measures of safety and control are implemented and enforced. The aim is to

find the most cost-effective method for a desired regulation level. If necessary, stakeholders may be included in the deliberations as they have information and know-how that may provide useful hints for being more efficient.

9.2 Epistemic processing involving experts

Resolving complex risk problems requires dialogue and deliberation among experts. Involving members of various epistemic communities which demonstrate expertise and competence is the most promising step for producing more reliable and valid judgments about the complex nature of a given risk. Epistemic discourse is the instrument for discussing the conclusiveness and validity of cause-effect chains relying on available probative facts, uncertain knowledge and experience that can be tested for empirical traceability and consistency. The objective of such a deliberation is to find the most cogent description and explanation of the phenomenological complexity in question as well as a clarification of dissenting views (for example, by addressing the question, which environmental and socio-economic impacts are to be expected by specific actions or events). The deliberation among experts might generate a profile of the complexity of the given risk issue on selected inter-subjectively chosen criteria. The deliberation may also reveal that there is more uncertainty and ambiguity hidden in the case than the initial appraisers had anticipated. It is advisable to include natural as well as social scientists in the epistemic discourse so that potential problems with risk perception can be anticipated. Controversies would occur less as a surprise than now.

9.3 Reflective processing involving stakeholder

Characterizing and evaluating risks as well as developing and selecting appropriate management options for risk reduction and control in situations of high uncertainty pose particular challenges. How can risk managers characterize and evaluate the severity of a risk problem when the potential damage and its probability are unknown or highly uncertain? Scientific input is therefore only the first step in a series of steps during a more sophisticated evaluation process. It is crucial to compile the relevant data and information about the different types of uncertainties to inform the process of risk characterization. The outcome of the risk characterization provides the foundation for a broader deliberative arena, in which not only policy makers and scientists, but also directly affected stakeholders and public interest groups ought to be involved in order to discuss and ponder the ‘right’ balances and trade-offs between potential over- and under-protection. This reflective involvement of stakeholders and interest groups pursues the purpose of finding a consensus on the extra margin of safety that potential victims would be willing to tolerate and potential beneficiaries of the risk would be willing to invest in order to avoid potentially critical and catastrophic consequences. The reflective involvement of policy makers, scientists, stakeholders and public interest groups can be accomplished by a spectrum of different forms such as negotiated rule-making, mediation, round table or open forum, advisory committee (cf.: Beierle and Cayford, 2002; Rowe and Frewer, 2000; Stoll-Kleemann and Welp, 2006).

9.4 Participative processing involving the public

If risk problems are associated with high ambiguity, it is not enough to demonstrate that risk regulation addresses the issues of public concerns. In these cases, the process of evaluation needs to be open to public input and new forms of deliberation. This starts with revisiting the question of proper

framing. Is the issue really a risk problem or is it an issue of lifestyle or future vision? Often the benefits are contested as well as the risks. The debate about smart cities may illustrate the point that observers may be concerned not only about technical risks of network failures or privacy issues being violated by information transfer but also about the acceptability of the desired goal to reduce choices for individuals by means of paternalistic design of choice situations (Kahneman, 2011, Thaler and Sunsteen, 2010). Thus the controversy is often much broader than dealing with risks only. The aim here is to find an overlapping consensus on the dimensions of ambiguity that need to be addressed in comparing risks and benefits, and balancing pros and cons. High ambiguity would require the most inclusive strategy for involvement because not only directly affected groups but also those indirectly affected should have an opportunity to contribute to this debate. Resolving ambiguities in risk debates necessitates a participatory involvement of the public to openly discuss competing arguments, beliefs and values. The set of possible forms to involve the public includes citizen panels or juries, citizen forums, consensus conferences, public advisory committees and similar approaches (cf.: Abels, 2007; Beierle and Cayford, 2002; Hagendijk and Irwin, 2006; Rowe and Frewer, 2000).

10. Conclusions

This paper attempted to expand the framework on risk governance in the direction of more adaptability and institutional capacity to include various actors and knowledge camps when addressing and regulating risks of urban planning. At the core of this paper was the idea of adaptive and integrative risk governance for urban planning and renewal. The goal has been to illustrate how the different components of pre-estimation, interdisciplinary risk estimation, risk characterization, risk evaluation, risk management as well as communication and involvement interact with each other and to demonstrate how the various combinations of complexity, uncertainty and ambiguity can be addressed by different risk management strategies.

This generic risk governance model can be transferred to the issue of urban planning. The risks that we are facing in urban planning are financial risks, physical risks (natural hazards), technological risks (building structures, infrastructure, hazardous facilities) and social risks (violence, social dissatisfaction). These types of risks are all interconnected and need to be considered when urban areas are planned and renewed (Renn and Walker, 2008a; Renn and Klinke, 2013).

The analytic distinction of risk characteristics – complexity, uncertainty and ambiguity – helps to facilitate an integrated approach to risk governance and urban planning. Whereas the analysis of simple and – to some degree – complex problems is better served by relying on the physical understanding of risks, uncertain and ambiguous problems demand the integration of social constructions and mental models for both understanding and managing these problems since urban planning affects the livelihood of people with all their beliefs, expectations and emotions. The distinction of risks according to risk characteristics not only highlights deficits in our knowledge concerning adequate risk handling in urban planning contexts, but also points the way forward for the selection of management options. Thus, the risk governance framework attributes an important function to public and stakeholder participation, as well as risk communication, in the risk governance process. The framework suggests efficient and adequate public or stakeholder

participation procedures. The concerns of stakeholders and/or the public are integrated in the risk appraisal phase via concern assessment. Furthermore, stakeholder and public participation are an established part of risk management. The optimum participation method depends on the characteristics of the risk issue. In this respect, all aspects that matter to people in urban planning enter into the various discourses through the images that the participants bring into the discussions. The need for finding an agreement on the respective time and space boundaries, underlines the necessity to understand and comprehend the various concepts and images that people associate with quality of life in urban environments.

References

Abels, G. (2007), Citizen Involvement in Public Policymaking: Does It Improve Democratic Legitimacy and Accountability? The Case of pTA, **Interdisciplinary Information Science**, 13:1, pp. 103-116.

Aven, T. and Renn, O. (2009), The Role of Quantitative Risk Assessments for Characteriz-ing Risk and Uncertainty and Delineating Appropriate Risk Management Options, with Special Emphasis on Terrorism, **Risk Analysis**, 29:4, pp. 587-600.

Armitage, D., Berkes, F. and Doubleday, N. (2007), **Adaptive Co-management. Collaboration, Learning and Multilevel Governance** (Vancouver: University of British Columbia Press).

Arvai, J. L, Gregory, R. and McDaniels, T. (2001), Testing a Structured Decision Approach: Value-focused Thinking for Deliberative Risk Communication, **Risk Analysis** 21:6, pp.1065-1076.

Beierle, T.C. and Cayford, J. (2002), **Democracy in Practice. Public Participation in Environmental Decisions** (Washington: Resources for the Future).

Berkhout, F., Hertin, J. and Gann, D. M. (2006), Learning to Adapt: Organisational Adapta-tion to Climate Change Impacts, **Climate Change**, 78, pp. 135-156.

Brooks, M. and Adger, W.N. (2005), Assessing and Enhancing Adaptive Capacity, in: Chopra, K., Leemans, R., Kumar, P. and Simons, H. (Eds.) **Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures**, pp. 165-181 (Cambridge: Cambridge University Press).

Burns, W.J., Slovic, P., Kasperson, R.E., Kasperson, J.X., Renn, O., und Emani, S. (1993), Incorporating Structural Models into Research on the Social Amplification of Risk: Implications for Theory Construction and Decision Making. **Risk Analysis**, 13:6, pp. 611-623.

Charnley, G. (2000), **Democratic Science: Enhancing the Role of Science in Stakeholder-Based Risk Management Decision-Making, Report of Health Risk Strategies** (Washington, DC: Health Risk Strategies).

Daft, R.L. and Weick, K.E. (1984), Toward a Model of Organizations as Interpretation Systems, **Academy of Management Review**, 9:2, pp. 284-295.

Earle, T. C. and Cvetkovich, G. (1994), Risk Communication: The Social Construction of Meaning and Trust, in B. Brehmer and N. E. Sahlin (eds) **Future Risks and Risk Management**, pp. 243-267 (Amsterdam: Kluwer).

Feldman, M.S. (1989), **Order without Design: Information Production and Policy Making** (Stanford, Cal.: Stanford University Press).

Filar, J.A. and Haurie, A. (Eds.) (2010), **Uncertainty and Environmental Decision Making** (New York et al.: Springer).
Functowicz, S. O. and Ravetz, J. R. (1992), Three Types of Risk Assessment and the Emer-gence of Post-Normal Science, in: Krimsky, S. and Golding, D. (Eds.) **Social Theories of Risk**, pp. 251-273 (Westport and London: Praeger).
Hagendijk, R. and Irwin, A. (2006), Public Deliberation and Governance: Engaging with Science and Technology in Contemporary Europe, **Minerva**, 44, pp. 167-184.
HM Treasury (2005), **Managing Risks to the Public: Appraisal Guidance** (London:www.hm- treasury.gov.uk/media/0/B/Managing_risks_to_ the_public.pdf; access: December 2012).
Hooghe, L. and Marks, G. (2003), Unraveling the Central State, but How? Types of Multi-level Governance, **American Political Science Review**, 97:2, pp. 233-243.
IRGC, International Risk Governance Council (2005), **Risk Governance: Towards an Integrative Approach**, White Paper no 1, O. Renn with an Annex by P. Graham (Geneva: IRGC).
Jasanoff, S. (2004), Ordering Knowledge, Ordering Society, in: Jasanoff, S. (Ed.) States of Knowledge: **The Co-Production of Science and Social Order**, pp. 13–45 (London: Routledge).
Kahneman, D. and Tversky, A. (Eds.) (2000), **Choices, Values, and Frames** (Cambridge: Cambridge University Press).
Keeney, R. (1992), **Value-focused Thinking: A Path to Creative Decision Making**, (Cambridge: Harvard University Press).
Keeney, R. and McDaniels, T. (2001), A Framework to Guide Thinking and Analysis Re-garding Climate Change Policies, **Risk Analysis**, 21:6, pp. 989-1000.
Klinke, A. and Renn, O. (2002), A New Approach to Risk Evaluation and Management: Risk-Based, Precaution-Based, and Discourse-Based Strategies, **Risk Analysis**, 22:6, pp. 1071-1094.
Klinke, A. and Renn. O. (2010), Risk Governance. Contemporary and Future Challenges, in: Eriksson, J.; Gilek, M. and Ruden, Ch. (Eds.) **Regulating Chemical Risks. European and Global Challenges**, pp. 9-28 (Heidelberg: Springer).
Klinke, A. and Renn; O. (2012), Adaptive and Integrative Governance on Risk and Uncertainty, **Journal of Risk Research** , 15:3, pp. 273-292.
Laudan, L. (1996), The Pseudo-Science of Science? The Demise of the Demarcation Problem, in: Laudan, L. (Ed.) **Beyond Positivism and Relativism. Theory, Method and Evidence**, pp. 166-192 (Boulder: Westview Press).
Löfstedt, R.E. (1997), **Risk Evaluation in the United Kingdom: Legal Requirements, Con-ceptual Foundations, and Practical Experiences with Special Emphasis on Energy Systems**, Working Paper No. 92 (Stuttgart: Center of Technology Assessment).
Löftsedt, R. (2005), **Risk Management in Post Trust Societies**, (London: Palgrave Macmillan).
Luhmann, N. (1993), **Risk: A Sociological Theory** (Berlin: de Gruyter).
Marti, K., Ermoliev, Y. and Makowski, M. (Eds.) (2010), **Coping with Uncertainty**. Robust Solutions (Berlin and Heidelberg: Springer).
Nelson, T.E., Oxleay, Z.M. and Clawson, R.A. (1997), Toward a Psychology of Framing Effects, **Political Behavior**, 19:3, pp. 221-246.

Pelling, M., High, C., Dearing, J. and Smith, D. (2008), Shadow Spaces for Social Learning: A Relational Understanding of Adaptive Capacity to Climate Change within Organisations, **Environment and Planning A**, 40, pp. 867-884.

Reese, S.D., Gandy Jr., O.H. and Grant, A.E. (Eds.) (2003), **Framing Public Life: Perspectives on Media and Our Understanding of the Social World** (Mahwah, NJ: Lawrence Erlbaum Associates).

Renn, O. (2008), **Risk Governance. Coping with Uncertainty in a Complex World** (Earthscan: London).

Renn, O. and Klinke, A. (2013), Space Matters! Impacts for Risk Governance, in: Müller-Mahn, D. (Ed.) **The Spatial Dimension of Risk. How Geography Shapes the Emergence of Riskscapes**, pp. 1-21 (Milton Park and New York: Routledge).

Renn, O., Klinke, A. and van Asselt, M. (2011), Coping with Complexity, Uncertainty and Ambiguity in Risk Governance: A Synthesis, **AMBIO**, 40(2), pp. 231-246.

Renn, O. and Walker, K. (2008a), Lessons Learned: A Re-Assessment of the IRGC Frame-work on Risk Governance, in: Renn, O. and Walker, K. (Eds.) **The IRGC Risk Governance Framework: Concepts and Practice**, pp. 331-367 (Heidelberg and New York: Springer).

Renn, O. and Walker, K. (Eds.) (2008b), **The IRGC Risk Governance Framework: Concepts and Practice**, (Heidelberg and New York: Springer).

Rowe, G. and Frewer, L.J. (2000), Public Participation Methods: A Framework for Evaluation, **Science, Technology and Human Values**, 25:1, pp. 3-29.

Skelcher, C. (2005), Jurisdictional Integrity, Polycentrism, and the Design of Democratic Governance, **Governance**, 18:1, pp. 89-110.

Stirling A. (2003), Risk, Uncertainty and Precaution: Some Instrumental Implications from the Social Sciences, in: Berkhout, F., Leach, M. and Scoones, I. (Eds.) **Negotiating Change**, pp. 33-76 (London: Edward Elgar).

Stoll-Kleemann, S. and Welp, M. (Eds.) (2006), **Stakeholder Dialogues in Natural Resources Management: Theory and Practice** (Heidelberg and Berlin: Springer).

Underdal, A. (2009), Complexity and Challenges of Long-term Environmental Governance, **Global Environmental Change**, 20, pp. 386-393.

Van Asselt, M.B.A. (2000), **Perspectives on Uncertainty and Risk** (Dordrecht and Boston: Kluwer).

van Asselt, M.B.A. and Renn, O. (2011), Risk Governance, **Risk Research**, 1:4, pp. 431-449.

Waldrop, M.M. (1992), **Complexity: The Emerging Science at the Edge of Order and Chaos** (London: Penguin Books).

Webster, D.G. (2009), **Adaptive Governance: The Dynamics of Atlantic Fisheries Management** (Cambridge, Mass.: MIT Press).

Zahariadis, N. (2003), **Ambiguity and Choice in Public Policy. Political Decision Making in Modern Democracies** (Washington: Georgetown University Press).