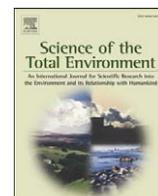




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# Integrated risk assessment and risk governance as socio-political phenomena: A synthetic view of the challenges

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## ABSTRACT

To call for integration in risk assessment and governance as a self-evident goal is deceptively easy. For more insight, we ask: what level and kind of integration and for what purposes is needed and sufficient? What opportunities and obstacles can be identified for integrative treatment of risks? What causes and impacts are there of developments in risk integration? To answer these questions we investigate the socio-political processes and factors surrounding integrated risk assessment and risk governance through a combination of literature reviews and original research. We emphasize regulatory assessment and governance of risks associated with chemicals in the EU, but we link them with other areas to better grasp options and problems in integration. We relate the problems to political factors and barriers in sector and vertical integration, including deviating interests, and further to conflicting information, concepts and mindsets. Risk assessment and risk governance involve varying notions of risks and knowledge, with tensions between stressor- or impact-oriented, exclusive or inclusive, positivist or relativist, and fixed or reflexive notions and approaches. These tensions influence the trajectories of integration between sectors, actors and regions, constraining the fulfillment of ideals of integrated governance. We conclude that risk assessment and governance can be integrated, harmonized and innovated to a limit only, but this limit is variable and flexible, and provides opportunities especially if attention is paid to the socio-political contexts, value choices and decision structures in each case. Generally, the results underline a reflexive approach whereby the meanings, framings and implications of risk integration are probed in open processes of deliberation and negotiation, as a learning process to transcend the formal and prescriptive modes of regulation and knowledge generation.

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## 1. Introduction

The concept of “risk society” (Beck, 1986) significantly increased interest in risk as a socio-political issue, prompting criticisms and clarifications (Alexander 1996; Abbinett, 2000; Elliott, 2002, Beck, 2000, 2006; Mythen, 2007; Renn and Keil 2008). Equally important, Luhmann (2005) provided a sociological theory of risk within a general theory of society. Regardless of the differences in perspectives, it is clear that the management of risks is not just about technical assessment and optimization of the risks as quantified entities. Risks have social and psychological dimensions, and are shaped by values, beliefs, political systems and cultural factors (Kasperson et al., 1988; Felt et al., 2007). Risks are multi-dimensional also because risks and responses to them – socio-political and technological – interact. All of these general risk characteristics also apply to chemical risks and to environmental and health risks from multiple stressors, which are in focus in this paper.

The many categories, dimensions and interactions of risks have led to concerns for multiple and cumulative risks. A key concern is that even if single risks could be near-perfectly assessed and managed, cumulative risks from multiple stressors may be unforeseen and unacceptable. One risk even when acceptable *per se* may exceed limits in combination with others; and the possibility of such surprises increases in complex systems. Assessing these cumulative risks is a major scientific and methodological challenge, but it is also a societal issue, not least because particularly such risks are likely to be distributed unevenly (National Environmental Justice Advisory Council 2004). Importantly for integrated treatment of risks, the selection of some risks over others is a key point of socio-political contestation, and is also culturally contingent (Douglas and Wildavsky, 1983).

It has consequently become important to develop risk assessment and management processes that facilitate many-sided consideration of the multiplicity of risks and of approaches to them. Risk integration moves from a straightforward task under a rather uniform paradigm of risk (such as biophysical) and of control (such as engineering or normative) to accounting for multiple risks in all their complexity. This task is influenced by the increased importance of dialogues, negotiation and participation among citizens and actor groups including ‘epistemic

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communities' (Haas, 1992; Hajer, 2003; Meijerink, 2005). These interactions between actors can thus be identified as a focal area in integrated risk assessment and governance (Craye et al., 2009).

Needs for risk integration arise from problems with fragmented knowledge, policy and actions. Broad overviews of multiple risks and of their contexts are typically needed when priorities are to be set for risk management. Yet, risks have been traditionally analyzed and managed by distinct sectors and groups who can be seen to represent separate Bourdieu (1975) "fields" with specific rules and characteristics. There are differences in risk governance between regions too (Kaiser and Prange, 2004; Jasanoff, 2005; Aarden et al., 2008). It is not self-evident how and if such differences can be harmonized or even accounted for. In addition to these relationships between groups, actors and regions, also the functional relations between risk science, risk assessment and risk governance need to be understood in order to manage risks efficiently.

To call for integration in risk assessment and governance as a self-evident goal is deceptively easy. For more insight, we must ask: what level and kind of integration and for what purposes is needed and sufficient? What opportunities can be identified for integrative treatment of risks? On the other hand, what obstacles are there and what problems are caused by over-ambitious integration? What causes and implications are there of developments in risk integration? To answer these questions we investigate the socio-political processes and factors surrounding integrated risk assessment and risk governance. We discuss specifically how novel methods for the assessment of cumulative risks may affect these processes.

## 2. Approach and methods

We review and synthesize earlier research on socio-political aspects of risks and risk integration, with particular reference to novel methods and approaches in the assessment and management of environmental and health risks from chemicals and other stressors. We complement this by theoretical and conceptual analyses of actor networks in the sense of transient material-semiotic phenomena (Callon et al., 1986; see also Latour, 1997; Kriesi et al., 2006; Schout and Jordan, 2008). We also apply and complement theories of cultural prototypes in risk perception as formulated by Hampton (1982) and co-workers (Douglas, 1989, 1996).

We approach risk assessment and governance as linked, multi-faceted, dynamic processes. Emphasis is put on the horizontal and vertical relations between actors, and the role of knowledge and its relationships with policy. For coherent discussion, the following frames are selected:

- geographically, we focus on the EU, but address its interactions with lower (national) and higher (global) levels of governance, as appropriate for our theme
- we emphasize risks from chemicals to human health and the environment, but apply a dual perspective on integrated treatment: stressor-oriented and impact-oriented (Fig. 1), to clarify and avoid the inherent limitations in treating it based on only one of these angles (such as chemicals or other stressors). It should be noted that the impact-oriented approach may encompass management consequences.

## 3. Definitions and concepts

A standard definition of *risk* is "the probability of an adverse effect in an organism, system or population caused ... by exposure to an agent" (IPCS and OECD, 2003), focusing on quantifiable biophysical entities. As pointed out above, risk is, however, a broader concept. Importantly, it includes social constructs (Macgill and Sie, 2004; Assmuth et al., in press). 'Scientific' risk is also a policy issue, as facts and values cannot be wholly separated (Rudén, 2006; Felt et al., 2007; Putnam, 2002). The

common dimensions in science-driven integration in risk assessment and risk governance thus include physical characteristics of risks (Fig. 2, left) that may have also some explicit socio-political aspects (IPCS, 2001). However, additional dimensions are distinguished more directly related to societal contexts (Fig. 2, right).

*Cumulativeness* of risks can mean their accumulation in time or along the stages in risk formation. Accumulation also takes place in space (hotspots) and in food-chains and other materials. According to USEPA (2003), cumulative risks mean "the combined effects from aggregate exposures to multiple agents or stressors". This definition combines the accumulation of responses or effects and that of agents or stressors.

Previously, a strict division was often presupposed between *risk assessment* and *risk management*, following the risk paradigm of NRC (1983). This has been often upheld in the EU, partly to assert the independence of assessment from politics such as with the scientific advisory bodies (ElAmin, 2006). An ideal of objectivity in assessment contributes to this division, and reflects a traditional view of expert knowledge (Edujee 2000). A more nuanced view has, however, developed of assessment-policy relationships (Rayner and Cantor, 1987; Jasanoff, 1995; Horlick-Jones, 1998; CEC, 2002d; Felt et al., 2007; Assmuth et al., in press). Risk assessment can be seen as reflecting socio-political systems and cultures, and as an activity that mixes facts with valuations of the frames and interpretations surrounding these facts (Wenzel, 1997). Also official definitions of risk assessment have become more inclusive (NRC, 1994, 1996, 2008; OECD, 2003a; Anon, 2009). Stakeholder involvement in risk assessment and governance has become more common, for example in the model procedures of OECD (2003a,b), Health Canada (2007) and the EU (CEC, 2002a, 2003b). IRGC (2005) went further and placed communication at the center of the risk governance cycle (cf. Renn, 2007).

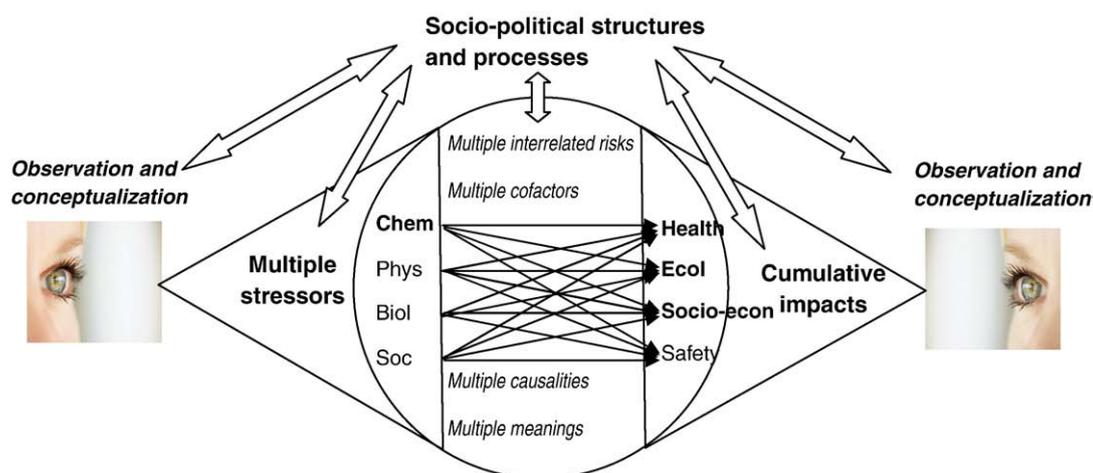
In definitions of *governance*, Treib et al. (2007) identified as common denominator "depart[ure] from the traditional model where collectively binding decisions are taken by elected representatives ... and implemented ... in public administrations". In general, governance emphasizes a change in the balance between state intervention and social autonomy. Risk governance likewise extends from regulations to multi-actor participation and negotiation and from technical management to legal, institutional, social and economic contexts (Renn 2008: 8). Integration in governance has usually meant vertical and regional integration (Egeberg, 2001) but is multi-dimensional. Horizontal integration between sectors (Chiti, 2004) thus involves also the alignment of risk governance in the sectors. Related concepts include (sector) policy convergence and coordination.

## 4. The EU governance and risk integration

### 4.1. Actors and activities in multi-level and multi-sector governance

The EU has generated new institutions and processes of regulation and governance (CEC, 2002c; Lyall and Tait, 2005). The vertical relations from supra-national to sub-national levels and associated interregional relations are complemented by the horizontal relations between sectors and policies (Knill, 2001), by the relations between actors groups (extending the horizontal dimension), and by the relations between elected and delegated or knowledge-based powers (Fig. 3; Bauer et al., 2007; Radaelli, 2008). Vertical and horizontal integration may compete (Jacob and Volkery, 2004), but have synergies also (von Beyme, 2005).

Risk governance, and especially integrated risk governance, brings together a wide range of actors. There is complexity both at a general structural level and within each box in the structure at global, EU and national levels (Fig. 3). In many issues regional and local actors also play an important role in risk related activities. The groups of actors have partly different foci and roles in risk governance, also 'cognitive' (Laffan, 2001). Parliaments for instance contain political groups which



**Fig. 1.** Complementary perspectives on risk integration, from cumulative impacts and multiple stressors. Note the social aspects of stressors and impacts and in the context of risks and of assessment.

have different views and preferences concerning risks (Benedetto, 2005) both specifically and generally, e.g. regarding precaution. Also the national views differ as shown by the debate over the EU's REACH (Registration, Evaluation and Authorisation of Chemicals) legislation of 2006 (Assmuth et al., this issue).

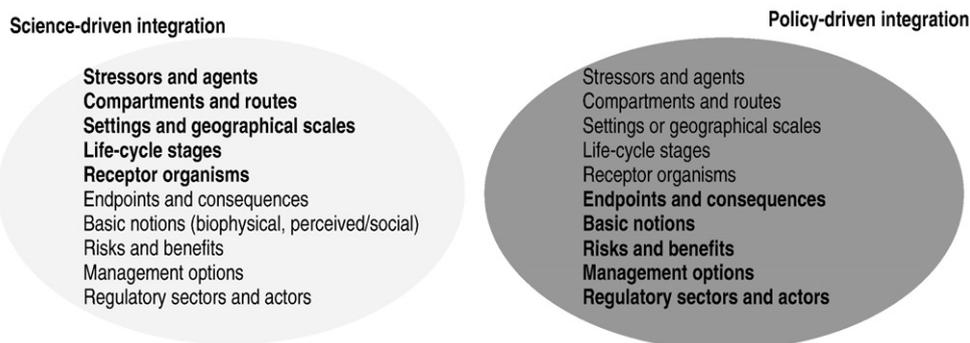
The involvement of private and other civil society actors is based on accepted policies (CEC, 2001) and in general implies broad, loose and informal integration. As a counterweight, new mechanisms of state influence are needed. For instance, public-private partnerships provide new opportunities through the inclusion of more actors but also new challenges in ascertaining the public interest in risk governance. New procedures and systems of negotiation and mediation emerge to resolve concerns, controversies and interest conflicts. These procedures and systems also include and affect the contents and conduct of risk assessments and what integration takes place in them. Environmental health is a case in point.

Specifically in chemicals control and risk governance, many actors, with their variable interests in and concepts of risks, influence whether and how integrated treatment of risks is achieved. Formal and legally based multi-actor governance is developing, for instance, under REACH (Assmuth et al., this issue), but is insufficient to cover cumulative risks from multiple stressors. Integration in this connection is often taken to involve mainly integration of substances, environmental compartments or biological effects, such as in the procedures for "Integrated Testing Strategy" and in other procedures e.g. for combining analytical chemistry measures and biomarkers (Blasco and Picó, 2009). This technical level of integration is important, but from the point of view of integrated governance

leaves out many crucial issues. These include the use of testing information in governance and, conversely, the feed-back to testing and other forms of information generation. Introducing novel methods for the assessment of cumulative risks from multiple stressors is thus not just about providing more sophisticated tools for existing fields and actors. The methods can also innovatively simplify and extend assessments, by bringing in new actors or modifying the roles of existing actors.

#### 4.2. Cultures of actor groups in risk governance

A number of basic ways to relate to risks have been collated to "cultural prototypes" of risk perception, based on simple models of adherence to a social group and 'grid' (lacking autonomy). The resulting prototypes have been given suggestive designations such as 'egalitarians', 'entrepreneurs', 'bureaucrats' and 'hermits' (Hampton, 1982; Thompson and Wildavsky, 1986; Douglas, 1989; Wildavsky and Dake, 1990). Such prototypes are relevant in risk assessment and risk governance, but not in simple and uniform ways (Wenzel, 1997; Sjöberg, 1999; Wilkinson, 2001). They co-exist with institutional structures and political processes (Swedlow, 2002) and with social processes and settings that influence identity formation and role enactment (Trondal, 2001). The approaches of groups to risks also depend on whether the context is dominated by consent, liability or trust (Rayner, 1990). Thus, the cultural roles (in the sense of human customs, institutions and achievements) of these actor groups and networks are an inseparable and interactive aspect of risk assessment and risk governance.



**Fig. 2.** Simplifying conceptualization of key dimensions in integrated treatment of risks. Common emphases in two approaches to integration are shown in bold (modified from Assmuth and Hildén, 2008).

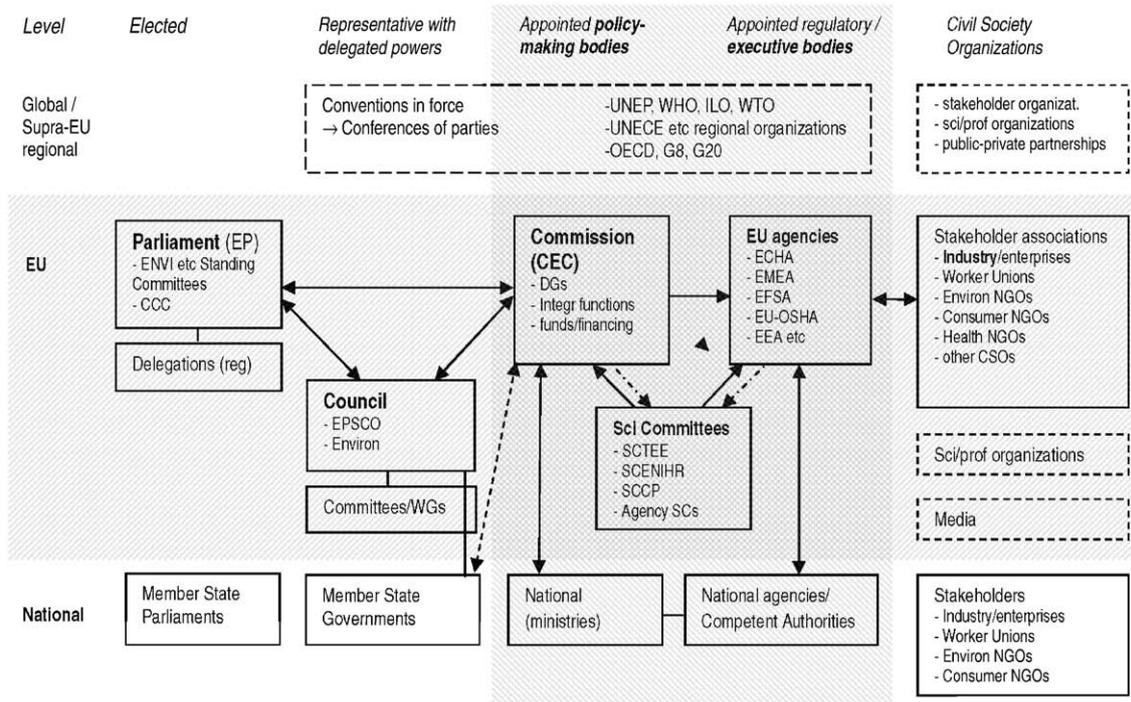


Fig. 3. Key institutions and actors at different levels of governance and democratic constituency for integrated risk governance in the EU, especially within environmental and health risks of chemicals. EU-level and executive bodies are highlighted. Note the ‘power’ triangle (EP, Council, CEC) and ‘execution-advice’ triangle (CEC, SCs, agencies).

We account for such factors in applying and developing the concept of cultural prototypes within integrated risk governance (Assmuth et al., 2009). For example, entrepreneurs in industry may suspect that the broadening of risk governance leads to stakeholder involvement that may invite criticisms and complicate management. They may nevertheless seek opportunities for avoiding conflicts through a collaborative strategy, as do entrepreneurs in political arenas (Benedetto, 2005). Egalitarians may also be critical of broad governance, believing that society should strive at zero risk and that multi-actor governance will legitimate risks through stakeholder influence (cf. Bomberg, 2007). Some NGOs oppose but others support broad participation, and may also be opportunist entrepreneurs. Bureaucrats generally see broad governance as a challenge as it requires changes in routines. However, since the ‘Kinnock’ reforms (CEC, 2001) the EU apparatus is infused with the idea of such governance (CEC, 2002d), largely to defend its legitimacy and position (Levy, 2006; Ellinas and Suleiman, 2008). ‘Eurocrats’ therefore endorse broad-based risk governance, if only as lip service.

The consideration of cumulative risks from multiple stressors adds complexity and new dimensions to these roles of actors. All prototypes can perceive needs and opportunities for integrated risk assessment and management but in different ways. Egalitarians will stress the balanced and democratic treatment of risks to all groups; the question will be how far the framings are stretched, e.g. as to sub-groups, and how the necessary weightings and tradeoffs between risks are defined. Entrepreneurs may see integration needs and opportunities mainly for their positions, and are likely to attack the multi-risk problem innovatively but incrementally. Bureaucrats prioritize integration needs and options within the confines and procedures of institutional structures that are rather formal, hierarchical and sectorized. Non-hierarchical and independent hermits, in an engaged version, may have a special role in the unconditioned flexible assessment and disinterested negotiations needed with multiple and multi-dimensional risks and uncertainties.

4.3. Horizontal integration

The types of risks addressed and integrated in the EU governance vary by sectors (Table 1). They are defined variously by economic activities or by entities or properties to be protected (health, environment, safety). The sectors have a range of policy instruments at their disposal, at different levels of intervention (Assmuth and Hildén, 2008). Coordination of the instruments, e.g. by the EU’s open method (Borrás and Jacobsson, 2004) is a key to integrated risk governance. Many attempts have been made, from general policy integration such as the Cardiff process to regulations in specific areas of integration such as IPPC (EP and EC, 2008) and environmental health (IPCS, 2004). Problems still persist: “across ... human health and the environment. ... lack of an integrated approach resulted in: ... compartmentalization ...; duplication of effort; failure of ... initiatives to make ... impact.” (Bridges, 2003: 15). There is also disagreement about the inherent idiosyncrasy and legitimate individuality of fields. The health field may, for instance, claim competence in comprehensively addressing health impacts and benefits of chemicals as well as other health factors and thus to inherently integrate risks; the environmental field, while usually focused on toxic effects of chemicals, may be integrative in other dimensions such as human ecology and environmental risk management (Assmuth and Jalonen, 2005).

There are overlaps between sectors of risk governance. For instance, chemicals control encompasses classification and labeling, registration, evaluation and authorization of industrial and consumer chemicals, pesticides and biocides (Assmuth et al., this issue). However, also many other areas of governance focus on chemicals, such as regulation of pharmaceuticals, cosmetics, food additives, radionuclides and nanomaterials. Other fields close to and even overlapping chemicals control include GMOs; water, soil, and air pollution; waste and product policy; public and occupational health; consumer and citizen safety; and energy (Table 1). These have variable and changing approaches to integrated risk governance. Normative and technological drivers such as standards

**Table 1**

Key traits of EU and state level actors and interventions in regulatory sectors important for risk policy integration (modified and extended from Herodes et al., 2007, based on EEA, 2005a).

Sector	Types of principal target actors	State intervention	EU intervention	Key EU-level policy instruments	Risk issues	Risk integration issues
Environment	Enterprises, citizens, CSOs (heterogeneous)	High (esp. some areas)	Low to high	Legal controls Economic and information based instruments	Biodiversity/habitat Climate change Invasive sp., GMOS Chemicals	Multistressor Multimedia Adapt/sustainability Environ pol integr Multifactoriality
Health	Service providers, clients	High	Low	Some legal controls Information based instruments	Diet, drugs, lifestyle Pathogens Chronic/ageing Contaminants	Environ + health Integr food safety Global health Integrated
Citizen security	Citizens, authorities	High	Low		Crime disasters (nat/tech)	preparedness + control
Agriculture (incl. veterinary)	Farmers, industry, consumers (many, cohesive)	High	High	Subsidies	Chemicals Pests GMOS Droughts/meteorology	Integrated pest control Food-feed quality Natural + social factors Climate change assess
Fisheries	Fishers, industry, consumers (few, cohesive)	Low to medium	High (hard-enforced)	Legal controls Subsidies	Overfishing Contamination Pathogens	Sustainable fisheries Integr. coastal zonemgmt/ marine policy
Industry	Producers, consumers + downstream	Medium	Medium	Legal controls Subsidies	Accidents (chem. etc) Nano, bio etc new tech Product liability/econ	Integr product policy Environ + health Total quality
Energy	Governments, producers, consumers	High	Low	Financial support Legal controls	Pollution (fuel./emission) Climate change Security	Fuel cycles System reliability Energy policy integration
Transport	Governments, industries, operators, users	High	Low	Limited financial support Legal controls	Accidents Air pollution Climate change	Integral safety Integral sustainable mobility systems
Common market	Producers, consumers	Low	High	Legal controls	Trade related	Harmonization Trade-risk links
Economics and finance	Governments, banks/financing, taxpayers	High	Low	Fiscal measures Legal controls	Financial risks Resource access Sustainability	Integral security and insurance Market + regulation
Development	Governments, producers, CSOs	Medium	Medium	Financial support	Water/infra Food security Climate adaptation	Multi-level integration Multi-sector integration

and aggregated information systems may engender sector integration, but also less formal forces and procedures are important for integrative risk assessment, such as the coupling of health impact assessment with strategic environmental impact assessment (Wright et al., 2005). However, the many levels of governance and the variety of actors complicate integrative treatment (Knill and Lenschow, 2005; Saurugger, 2005; Kriesi et al., 2006).

#### 4.4. Vertical integration

The vertical dimension involves contrasting directions: globalization and localization (Lazer, 2001). Despite 'Europeanization' and transposition of regulations, there are differences between Member States (Eberlein and Grande, 2005), especially in Eastern Europe (Bauer, 2006; Getimis et al., 2001; World Bank, 2009). Integration and convergence thus concur with sub-EU variability (Bugdahn, 2005; Bulmer, 2007). As stressed by Knill (2005), the factors influencing this balance are poorly understood. The failures of EU transposition have been explained both by the nature of the specific policy instruments and obligations and by general factors (Etherington, 2006). The latter include endogenous processes such as institutional bargaining and constitutional compromises (Moravcsik, 2005) and exogenous such as resource spillover (Farrell and Héritier, 2005). With enlargement and economic and political pressures, also bloc-building plays a role. Benz and Eberlein (1999) took an optimistic view of the possibilities to avoid regulatory overloads in multi-level governance based on French and German data. The processes elsewhere are more difficult, even in old Member States when the legal role of the state is weak (Giglioli and Swyngedouw, 2008).

The key problem is how to interpret the subsidiarity principle in the context of risk assessment and management: are Member States or their regions allowed to create their own interpretations of cumulative risks and procedures for assessing these, or only to develop solutions in accordance with harmonized processes and legally specified criteria at the EU level? For chemicals the tendency is towards the latter, justified by the Treaty of Amsterdam (1997) which supports community action when "actions by Member States alone ... would conflict with the requirements of the Treaty (such as the need to correct distortion of competition or avoid disguised restrictions on trade or strengthen economic and social cohesion) or otherwise ... damage Member States' interests". The appropriate level of Member State influence is a matter of debate and there is great variation between areas of governance. For example land use planning allows specific approaches to integrated treatment of risks, applying EU-level requirements in the geographical context. Here weakly harmonized methods for cumulative risks can account for regional aspects. Vertical coordination is however not simple in any sector (Benson and Jordan, 2008; cf. Blom-Hansen, 2005; Schäfer, 2006). It also depends on the circumstances, as found by Krapohl (2003) with the balance between the deliberative supra-nationalism of scientific committees and the inter-governmental function of oversight committees.

The EU is increasingly part of regional and global political and economic systems. This adds a level of complexity that poses a challenge to the EU and specifically to risk assessment and governance (Luhmann, 2005; Beck, 2003, 2006). There are opportunities and problems for integrated treatment of risks in this expanding scope and connectedness of socio-economic and political systems. The problem is often the lack of political and legal mechanisms at supra-

EU levels, as in the governance of global flows of chemicals (Assmuth et al., [this issue](#)) and of biotechnology, which is also closely linked with international relations and trade (Millstone et al., 2008).

#### 4.6. Change and innovation in integrative risk governance

Many social, political, technological and environmental changes influence integration in risk governance. Societal changes may be intentional or not; they inhibit or promote integration; and they affect both the substance and the conduct of risk assessment and governance. The developments are related to processes and factors in the polity (institutional structures), policy and politics domain, such as constitutional agreements, delegation of powers, enlargement, and the role of state (Kaiser and Prange, 2004; Treib et al., 2007). These developments and factors are reflected in the integration of risk governance in and between the various sectors of the EU, including those that address chemicals, environmental management and health care (Table 1).

In addition to and underlying these political and institutional processes, risk governance is influenced by substantive changes such as increased scarcity of resources and energy; economic and financial turmoil, global and regional crises (including those prompted by risk controversies) and demographic changes. These contribute to increased psychological sensitivity to risks, especially those related to health and security. The EU policies are consequently evolving, albeit unevenly and through 'punctuated equilibria' (Meijerink, 2005). The evolution of policy cycles from conception to follow-up involves vertical and horizontal integration and multi-actor negotiation through organized policy coordination (Bauer, 2006), but also informal policy learning takes place in the EU as a 'system of innovation' (Borrás, 2004).

There is path dependency in the evolution of risk governance, but it is difficult to predict. Complex political, social and cultural processes combine to mold it, and are in turn affected by technological development. On a substructure of historical forces, stochasticity is thus superimposed (Kracauer, 1995 (1969)). This is related to the uncertainty in complex interactions, pronounced in to-day's world (Hajer, 2003). The result is dynamic co-evolution at many levels: between institutions, sectors and polities; between society and technology; between society and nature. New methods play a role in this: for example, the detection of chemicals at smaller concentrations and of new effects has made risks "visible", leading to demands for regulation and assessment.

While new risks and problems can emerge rapidly, regulatory systems may be slow to react. However, sometimes changes are made on short notice, even as 'solutions looking for problems' (Zahariadis, 2008). Multiple time scales are thus imposed on each other, such as the quartile economy on slower legal, organizational and cultural changes, but generally getting faster. The implication is that governance is constrained by inertia, but also doomed to cope with changes. Some punctuation by crises can be discerned as crossroads in the trajectories of EU risk governance in relation to integration and precaution. For example, the accident at Seveso, Italy in 1974 triggered EU-level responses such as the directive 82/501/EEC on industrial accidents and the more comprehensive Seveso II directive 96/82/EC on resultant hazardous wastes and materials; later food dioxin scandals eventually lead to the formulation of the Community dioxin strategy of 2001, and contributed to EU's activities in the POPs Convention. In some thematic actions, such as the development of a Community chemicals policy, integration of sectors, actors, levels and issues in governance has been stressed. Other actions and instruments such as the REACH legislation have been confined to integration in a limited sense and at detailed level, but have also made attempts at some new areas of integrated risk governance and at the operationalisation of precautionary approaches (Assmuth et al., [this issue](#)).

Our interpretation is that regulatory changes are often triggered by specific events, which can be random, but the outcomes are affected by general directions and factors in policy and politics, such as converging interests of sectors or countries, and also by overall

cultural approaches to risks. On sustained converging interests, responses are revised and broadened (e.g., Seveso and IPPC Directives). Regulations in turn drive the interest in issues and induce findings. The regulations and the outcomes are related to methodological development. For example, the priority substance list in the Water Framework Directive can be largely traced to 'events' and not only to systematic and *ab initio* prioritization, but details such as the requirement to measure chemicals in the water phase depend on existing test methods. Some links involve vicious circles: those substances that have been prioritized are mainly measured and can be prioritized. Methods for risk assessment respond to but also influence both the details and overall approach; they mediate and synthesize risk information although do not provide new findings of risks in the way empirical observations do.

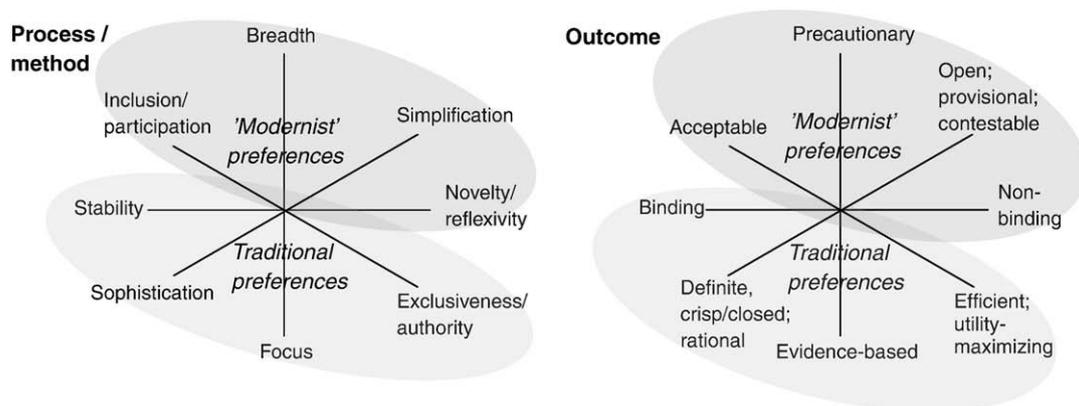
## 5. Discussion

### 5.1. Socio-political aspects of the multiplicity and multi-dimensionality of risks

The socio-political aspects of risk assessment and risk governance are pronounced in the case of cumulative risks from multiple stressors. With such risks, issues arise beyond the usual social amplification (Kasperson et al., 1988) and attenuation of risks. The selection of some risks among many is influenced by the cultural setting and implies downplaying many other risks (Wildawsky, 1995) although there can be some mutual amplification of the risk selected and corollary risks. The consideration of additional risks may reduce the significance of those risks originally in focus, e.g. chemicals as compared to other risks to health and the environment. However, a broadened focus may also turn out to emphasize the risk of initial concern, depending on its perceived characteristics and roles as a part of a whole, such as if accumulated chemicals are seen to break the 'camel's back' or to be the risks that are most amenable to control. In either case, emphasizing or de-emphasizing one risk among many, the multiplicity and multi-dimensionality of risks present challenges particularly for those focused on one risk or interpretation.

Integrated risk assessment and management represent attempts to grasp and solve multiple and multi-dimensional risk problems. This will take place in any case at the integrative level of regulation and resource allocation, but often *ad-hoc* and *a posteriori*, on a linear model (Renn and Keil, 2008). It seems generally better to address such problems up front, to avoid excessive work on some risks and counterproductive conflicts, and instead to enable negotiation and learning between fields. The counter-argument is that also single risks need to be focused on within the limits of existing fields, of which all cannot be involved. A combination of these holistic and specific or incremental approaches seems a natural way out of such argumentation. As the holistic, more ambitiously integrative approach is strengthened, the conflicts between entrenched fields tend to move to framing, the "bottleneck of legitimate institutions" (Kohler-Koch, 2000). Dialogues and negotiations in this case may more easily resolve conflicts and generate innovative joint solutions.

Also the context dependency of risks and of risk governance, specifically of cumulative risks from multiple stressors, suggests that regulation which is flexible and includes elements of reflexivity can provide a basis for integrated assessment and governance of such risks. The challenge is how to balance this 'modernist' approach with the requisite clarity, predictability and normativity (Fig. 4). Particularly in the case of integrated risk assessment and risk governance of multiple stressors, broad and loose framings in both substance and conduct have to be balanced with specified and coherent framings. A partial solution may be found in novel combinations of procedures that enhance negotiation of framings, goals and means, as seen in the case of REACH (Assmuth et al., [this issue](#)). This is akin to avoiding underestimation of the forms of mobilization affecting both cognitive



**Fig. 4.** Simplifying juxtaposition of key qualities of the processes and outcomes of risk governance, with particular reference to integration. Qualities valued traditionally in risk assessment and regulation and commonly in reform movements of governance and expertise are highlighted. Note that the appropriate balance depends on the case.

and normative frames (Surel, 2000), or both the material and semiotic aspects of actor networks (Latour, 1997).

It has been claimed that society has shifted from representative to participative democracy; from centralized government to networked governance; from decisiveness to consensuality (CEC, 2001; OECD, 2002; Hajer, 2003). This shift is not self-organized but has an element of central steering that influences policy coordination (Schout and Jordan, 2005). As seen above, participation is stressed also in risk governance (Craye et al., 2009); it is particularly important because of the charged nature of risks (Beck, 1986; Johnson, 2005). These ‘malign issues’ (Nilsson and Persson, 2003) prompt political bargaining that weakens mutual learning and policy integration. Participation can counteract this, enabling actors to frame risks broadly and facilitating many-sided deliberation. It can however be questioned whether these shifts are real or aspirations, and how strong and lasting they are; a swing of the pendulum to a more bounded interpretation of integration and of expertise is possible (cf. Löfstedt, 2004). There are also caveats to multi-actor governance. It may enable a shift toward private interests, a “crisis in governmentality” instead of governance (Bailey, 2006), as opportunism flourishes in ambiguous coalitions of ‘interface actors’ (Knill, 2001). As put by Eberlein and Grande (2005): “the informalization of governance is vulnerable to strong distributive conflict, and ... raises ... problems of democratic legitimacy”. Multi-actor governance is thus no panacea for integrated risk governance. Attention is required to the qualities of the process and the outcomes, to ensure broad and efficient as well as equitable risk management (Fig. 4).

## 5.2. Harmonization and integration of risk governance

Harmonization and standardization are often emphasized in international and integrative risk governance (DG-SANCO, 2003a; ISO, 2008; cf. Abbott and Snidal, 2001). In the EU, harmonization is a ‘mantra’ due to the core idea of common market and the perceived need to eliminate the divergence of goals and means that is judged to unduly limit the market. The idea of harmonization underlies many developments also in EU risk governance (DG-SANCO, 2003a,b). Integration and harmonization should however not be confused, and neither is to be accepted uncritically. Integrative treatment of risks can involve the comprehensive, e.g. comparative consideration of non-commensurate risks and of individual risk concerns without imposing normative requirements on harmonization.

With diverse risks, harmony is unattainable: “so many circumstances of a small and accidental nature are relevant that no broad and simple uniformities are possible” (Russell, 1948). Limits to harmonization are however often downplayed (Assmuth and Hildén, 2008; Assmuth et al., 2007). For instance, harmonization of one aspect of risks from a chemical, such as its ecological effects, and the testing and

assessment procedures used to define these effects, can jeopardize harmonization of another, such as its health effects or its benefits. As discussed above, there are also justifiable differences between regions and sectors and their respective management goals and approaches. Even when convergence is desired, there are many alternatives to harmonization in achieving it, including coercive imposition, competition, regulatory diffusion and policy learning (Busch and Jörgens, 2005; Anon, 2006). The tolerance of asymmetries is a key issue in all these measures and in all dimensions of integration (von Beyme, 2005).

Idiosyncrasy and integration are thus not antithetical but complementary (Jones, 2003). Instead of trying to harmonize things at a level unattainable, variation can be embraced by facilitating consideration of specifics and contexts, as seen with vertical integration. This suggests that a context-sensitive pluralistic way of integrating different aspects of risk for governance should be seen as a way forward. Significant barriers are nevertheless likely to be encountered.

## 5.3. Barriers, opportunities and limits of integration of risks

Several types of barriers for integrative risk assessment and management are identifiable (Assmuth and Craye, 2009): in knowledge (epistemological and ontological barriers), in regulation, for instance administrative capacities (Schout and Jordan, 2008), and in socio-political factors (also cultures). These are not separate; for instance, cultural factors influence knowledge and administration, and institutions can be seen as both regulatory and political barriers. Accordingly, institutionalist models can be combined with models of world views and identity formation (Surel, 2000). Further, in a more evaluative view, the above analysis and discussion indicates that the barriers of integration include more and less justified limitations. Overcoming them cannot therefore be a generic objective. The evaluation will depend on the more precise meanings of integration in each case.

Basic concepts (ontologies) and methodological approaches can limit possibilities for integrative treatment of risks. Also allegedly integrated risk assessment can have limitations related to the knowledge they engender and deliver. Focusing *a priori* on one stressor such as chemicals carries a limitation, as noted by NRC (2008) regarding the cumulative risk assessment of the USEPA. Cumulative risks thus need to be approached also from the perspective of effects. This is a reality check that may, for instance, reduce fixation on synthetic chemicals (Ames and Gold, 2000) or on other stressors believed to cause top risks. Uncertainties arise due to problems in attributing risks to causes. Higher-level questions of the meaning of the cumulative risks involve competing concepts of realism, such as how qualitative differences of risks including social aspects affect risk commensurability and prioritization (e.g. whether the attention on

synthetic chemicals or other modern worries is 'really' disproportionate; see Assmuth et al., this issue). Concepts of integration have been extended from physical to social realms also for instance in integrated product policy (Rubik and Scholl, 2002). However, the socio-psychologically charged nature of risks poses particular challenges that are accentuated by their multiplicity, multi-factoriality and multi-dimensionality. This underlines the need for dialogue and pluralistic deliberation, but also regularly makes those engaged resort to a simplistic notions and claims of knowledge.

Institutional barriers are equally important. Guttier (2004) argued that the coordination between overlapping sector competences in the EU has been too timid. This coherence deficit is common between health and environmental sectors, despite some integration (CEC, 2003a; DG-SANCO and SCHER, 2006; DG-SANCO, 2008). Cohn (2004) showed that also complex policies can succeed if there is consensus of goals; this lacking, all types of solutions including simplification and restriction hoping for knock-on effects in other fields have drawbacks. For instance, Environmental Policy Integration has been criticized for a lack of concrete 'bottom-up' integration with other sectors (Jordan et al., 2003), but also for diluting environmental policy in other fields (EEA, 2005a, b; Herodes et al. 2007), implicitly assuming a lack of common goals. There are notable institutional barriers also in vertical relations between the EU, its members and regions, and the global community. They can be particularly hard to enforce because of questions of sovereignty and power.

Everything cannot be integrated, and trade-offs are needed (Suter et al., 2003). The capacity of social systems to address risks, old and new, is limited. Simplification of governance (CEC, 2002b) can make some integration easier, for instance by dismantling hierarchies, but it can also prevent some integration, if coordinative functions, regulatory oversight and the ability to take on new cross-cutting issues are diminished. Differences between sectors, regions and actors create barriers, some even permanent, but convergence and integration in some dimensions may be possible. If for instance integration of human health and ecological risks (due to scientific or policy differences), or of stressors (such as chemicals in different contexts) is not practicable in a prescriptive way at detailed level, integration may be achieved flexibly and at general level (DG-SANCO, 2003b). The barriers depend also on the risk in question. Stressors that act through the same media, such as food, are for instance in some respects easier to integrate than those that occur and act through different media or compartments, or generally represent different categories.

## 6. Conclusions

The multiplicity, multi-dimensionality and cumulateness of risks are conspicuous issues in governance, and underlie many controversies about risks. Specifically, along with multiple stressors, their multiple impacts need to be grasped. This complicates integrated risk assessment but also points to some possibilities to develop it for fuller relevance in both scientific and policy terms, i.e. allowing a grasp of the complex reality of risks in ways that better reflect both the scientifically tractable phenomena and the socio-political needs amidst this complexity. The following conclusions emerge from our broad analysis.

- In developing integrated risk assessment and governance one should recognize the multiple dimensions of risks and of integration and hence reject the idea that uniformity in concepts, contents and methods could solve all problems of integration. Communicative learning processes should be emphasized instead, but these demand development of dialogues across the different actor fields in risk assessment and governance.
- Integrated risk governance in the EU takes place in and needs to be developed in many sectors and between different levels of governance from global to local. Both of these involve multi-actor participation

and negotiation. On the other hand, responses on risks influence developments of overall governance. Risks associated with chemicals are part of a palette of risks, including risks from loss of benefits and countervailing risks from management. This requires broader scopes and revised approaches to risk assessment and management.

- There are important knowledge-related, institutional and other socio-political barriers to developing and applying integrated risk assessments, also of cumulative risks from multiple stressors. The barriers are of varying strength and permanence. Identifying and exploring barriers can create openings for integration also in new and unexpected ways, especially by bringing in views from actors.
- Methodologically, reflexive, flexible and more transparent approaches to risks are advisable as part of and support for open processes of risk communication, negotiation and governance. Different framings, assumptions and valuations of risks can thereby become clearer, and cumulative risks of multiple stressors can be addressed at the levels and with the types of integration that is appropriate to the purpose, acknowledging also the need for formal, specific, constant and robust approaches. An important element and value of such an open reflexive approach is that it can be revised while being anchored in democratic deliberation and in existing knowledge.

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