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Chapter 6

Conclusions and Recommendations – An Action-oriented Agenda

Abstract. *An over-arching conclusion drawn from the analysis in this report is that emerging systemic risks demand a systemic response. This final chapter presents a set of general recommendations for public sector and private sector decision-makers that provide some of the elements for such a response. They are grouped under five major headings: adopting a new policy approach to risk management; developing synergies between the public and private sectors; informing and involving stakeholders and the general public; strengthening international co-operation in all elements of the risk management cycle; and making better use of technological potential and enhancing research efforts.*

Introduction

Over the years, OECD member countries have developed procedures and institutions to protect human health, property and the environment from damage caused by a wide variety of hazards. At the same time, OECD societies have become increasingly demanding with respect to the levels of risk they consider acceptable. In most cases, risk management policies have been successful in reducing risks to these levels. However, as witnessed by a number of recent disasters – ranging from major food-related health crises to the events of 11 September 2001, these policies are now facing new challenges.

The first part of this report described the driving forces that have begun to change the landscape of risk management, or that are expected to do so in the coming decades: demographic changes, including population growth, migration, ageing, and urbanisation trends; environmental changes, notably the wide-ranging impacts of global warming; technology-driven changes, from growing connectedness to specific risks linked to some recent technologies; and finally, socioeconomic changes ranging from rising inequalities to increased concentration in some industries and markets.

The body of the report considered the ensuing challenges for each phase of risk management. First, concerning assessment, it will become necessary to take better account of the natural and human context of risk. In addition to sound risk assessment, the limits of scientific knowledge and value considerations will be of increasing importance in determining the level of risk that is acceptable and the means of reaching it. In this context, it will prove challenging to ensure both the consistency and the transparency of the decision-making process. Second, concerning risk prevention, knowledge and information will have to be mobilised, specific infrastructures better designed and more diversified, and co-operation increased in order to reduce exposure to and increase resilience against specific hazards. At the same time, the framework conditions for risk prevention – the information and incentives provided by laws and regulations – will need to be improved. Third, with regard to the management of emergencies, the report identified challenges in the collection of information, in communication with the media and the public, in the efficiency of rescue services, and in disaster containment. Fourth, the recovery issues considered included maintaining business continuity, restoring trust and avoiding stigmatisation, determining liabilities and providing compensation, addressing insurability problems, and learning

lessons. For each of these challenges, the report identified emerging responses.

This final chapter draws general recommendations for action from the analysis, under five major headings: adopting a new policy approach to risk management; developing synergies between the public and private sectors; informing and involving stakeholders and the general public; strengthening international co-operation in all elements of the risk management cycle; and making better use of technological potential and enhancing research efforts. These provide elements of a systemic response to emerging systemic risks.

1. Adopting a new policy approach to risk management

Risk management is often narrow in scope. This is sometimes the result of a partial approach that does not consider – usually for practical reasons – a number of relevant factors. One example is assessment of risks related to the release of a hazardous substance into the environment which ignores the lifestyles of exposed populations. Another is emergency planning based on misperceptions of human behaviour. Narrowness can also result from a failure to consider linkages between the various stages of the risk management cycle. For example, liability and compensation rules can be designed and applied regardless of the contradictory impact they might have on incentives to prevent a certain risk. And the occurrence of a disaster seldom leads to an overall re-examination of how risk has been handled up to that time.

Such lack of scope may be heavily penalised in times of significant change in the risk landscape. The challenges ahead clearly call for a new approach to risk management. Specifically, there are three areas in which substantial progress could be made: the overall view of risk; the consistency of risk management; and the coherence of risk regulations.

Recommendation 1: Adopt a broader view on risk

Risk is multidimensional – a variety of factors influence the nature of hazards as well as exposure and vulnerability to them. Such factors are bound to become even more diverse in a world where obstacles to the movement of people, goods, capital and information are reduced while physical, informational and economic linkages are multiplying. Tailoring a given risk policy to the environment in which that risk arises entails integrating, to the extent possible, the complex interactions of these factors.

1.1. Enhance multidisciplinary in risk assessment and management

In many areas, risk assessment needs to go beyond the traditional approach's focus on probabilities of occurrence and direct consequences. It

must take better account of the environmental, human, behavioural and social factors affecting the transmission of and exposure to hazards. In addition, risk management policies have to take into account the effects they are likely to induce. Today, to overlook such linkages is often to blunt the effectiveness of policies, possibly even to render them counterproductive.

In order to broaden the perspective on risk issues, additional emphasis must be placed on bringing together specialised knowledge in every aspect, from “hard” sciences to psychology, sociology and economics. Two important facets of such a multidisciplinary approach are to build more diversified competencies within each component dealing with risk management, and to establish procedures for enhancing dialogue between disciplines.

1.2. Consider communication and levels of acceptance as an integral part of the risk issue

Many recent risk management failures have resulted first and foremost from two major shortcomings: an inability to understand the public’s acceptance level for a given risk/benefit situation, and a tendency to consider communication with the public as an issue separate from risk management. Policies need to pay increased attention to the information the public actually has about risks and benefits, and to the way it is likely to (rather than should) react to a particular measure.

Better integrating communication and levels of acceptance means that risk management authorities must never lose sight of the public’s trust as an irreplaceable asset. They must be open to the variety of standpoints on risk, and dialogue effectively with the public. These points are discussed in more detail in Section 4 below.

1.3. Detect changes in the risk landscape early

Those responsible for risk assessment and management also need to be on the lookout for changes in the factors influencing risk. A number of driving forces – from demographic and socioeconomic to environmental and technological – have started to alter the risk landscape, and will continue to do so in the coming years. For example, management of natural disasters, from hazard assessment and insurance schemes to emergency planning, needs to integrate the possible influence of global warming. Industrial safety assessments and regulations should monitor market conditions more closely and, when substantial damage is possible, anticipate their influence on risk.

By assembling the contributions of various bodies of knowledge and by paying more attention to the prospective study of risk, forward-looking assessment should contribute to a more proactive and responsive management of risks.

Recommendation 2: Examine the consistency of policy across risk areas

This report considers a wide variety of risks, from natural disasters (floods, storms, earthquakes, etc.) through infectious diseases, food safety and technological accidents (fires, explosions, crashes, etc.), to malevolent actions assimilated to terrorism (cyber-crime, bioterrorism, catastrophic terrorism). Policies have usually evolved in isolation in these various areas, with little attention paid to the overall allocation of society's resources to risk reduction. As a consequence, major discrepancies are observed in policies towards risk in all OECD countries.

Three recommendations are made to examine and improve policy consistency across risk areas: first, determine – with the help of cost-benefit and decision analysis tools – the optimal level of risk that should be targeted in each case; second, compare risks and define priorities; and third, share lessons and best practices between risk areas.

2.1. Target an accepted level of risk

Reducing risks entails costs as well as benefits. It necessitates the development of human, capital and knowledge resources that come at a price, and might also mean limiting the development of a technology or the exploitation of a resource, thus losing potential benefits. Conversely, it limits damage caused by a hazard and can induce positive externalities, *e.g.* in terms of job creation and growth in specific activities.

In most cases it can be reasonably stated that there is an optimal level of risk, at which costs and benefits of risk reduction are in balance. Sometimes, however, there may be too much uncertainty regarding the possible consequences of a hazard to evaluate the costs and benefits with a sufficient degree of confidence. In addition, the amount of risk that is acceptable can depend upon ethical and social considerations difficult to quantify in terms of costs and benefits. Therefore, while risk policy – as any policy area – needs to be optimised, the process of optimisation has to be broad and flexible enough to consider all pertinent aspects of the risk issue, from the costs and benefits of various measures to the uncertainties and value issues involved.

Such a decision improvement process could provide a road map to decision-makers to identify the level of risk that is acceptable on a case-by-case basis. It could use a variety of tools, from relatively restricted notions such as “As Low As Reasonably Achievable” (ALARA) to more comprehensive processes of cost-benefit and decision analysis. Naturally, a more complete assessment of the risk issue will call for tools that are more demanding in terms of data and time. The choice of analysis must be tailored to the situation: the urgency of decision, the severity of potential losses, the degree of scientific uncertainty, the importance of social controversies, and so on. As

explained in detail in the report, the aim of such methods should not be to provide a “black box” solution to risk management but to help bring to light facts, uncertainties and values without overlooking any of the factors of interest to optimal decision making. Stakeholder input is essential in identifying a solution that will be accepted.

2.2. Prioritise risks

The wide discrepancies in what is considered an acceptable level of risk in different areas (or, similarly, the accepted cost of averting a fatality) have been documented in the past decade for most OECD member countries. For instance, many countries show very low risk aversion when it comes to exposure to radon gas inside homes, and at the same time particularly high aversion to nuclear accidents. Such differences might indicate that resources used to reduce risk in one area would be more productive in another.

Even though responsibilities for handling risks are often widely dispersed, the overall resources available are limited and should therefore be allocated as efficiently as possible among the existing risks – whether in a firm, a municipality or a country. This entails comparing, ranking, and prioritising risks. However, as they are a mixed bag of measurable facts, uncertainties and value judgements, risks are not always easy to compare. Methods have been developed in recent years to help overcome such difficulties but again, they must be seen as tools to structure and facilitate public debate rather than as technical procedures to be followed mechanically. Recommendation 8 below deals specifically with public consultations on risk issues.

Such methods would help determine whether disparities in accepted levels of risk result from actual differences in risk features; from uneven states of scientific knowledge; from the variety of societal values involved; or, if they simply pinpoint inefficiencies in the allocation of resources.

2.3. Exchange information and share best practices among sectors

Naturally, each risk area considered in this report has its specificities, and handling each calls for specialised knowledge. At the same time, many management issues are common to a variety of areas, and therefore much could be learned from the exchange of information and identification of best practices across sectors. To take just one example, the nuclear industry has accumulated substantial experience with respect to involving stakeholders in risk decisions. In some countries, consultation processes have yielded very positive results in the siting of radioactive waste repositories. This experience could be highly beneficial to other industries that deal with hazardous substances.

Many OECD countries have only recently engaged in the cross-sectoral analysis of risks, through the study of transversal issues such as precautionary policies and risk communication. More systematic exchanges, underpinned by adequate institutional frameworks, still need to be organised.

Recommendation 3: Improve the coherence of risk management

Risk management policies also face the challenge of internal coherence. Policy makers can use a wide range of tools to manage risks, including the provision of specific goods, services, infrastructures and information; norms and standards; tort law; insurance and reinsurance regulations; and economic incentives, deriving in particular from taxes and subsidies. Policy efficiency and effectiveness require that each instrument be used in contexts where it has the most impact and supports the action of other instruments. In practice, however, risk policies often lack such coherence.

More attention should also be paid to consistency over time. Risk management can aim at controlling a risk at various stages of its development: when it is a hypothetical possibility, when it is first observed, or when it is well known. As uncertainties are reduced, as factors of risk unfold and social norms evolve, regulations have to be refined and sometimes drastically modified. Such changes can be extremely costly if past regulations become inconsistent.

There would seem to be room for improvement in the coherence of risk policies in three areas at least: first, in gaining a better understanding of regulation concerning each specific risk; second, in increasing co-ordination and exchange of information among the various phases of risk management; and third, in favouring flexible risk policies.

3.1. Achieve better understanding of the overall effect of regulation on each specific risk

It is first necessary to improve our understanding of how the various elements of regulation (or the absence thereof) shape behaviours and contribute to the final risk picture. Complementarity and synergy between instruments such as tort law and insurance, for instance, should be assessed more fully. The ideal situation would be to have a complete description of the regulation regime as applied to each type of risk. Only on the basis of such an improved understanding can a strategy for risk management be defined consistently, and the most appropriate mix of risk policy instruments chosen.

3.2. Increase co-ordination among the various phases of risk management

Second, co-ordination among the various phases of the risk management cycle can be substantially improved. Recent episodes of flooding in Europe

showed, for instance, that surveillance systems can send early warnings long in advance, but that these may not be received or treated appropriately by the local authorities and endangered populations, or may not be followed by effective protection or evacuation measures. Too often, even with correct assessments and effective early warning systems, proper contingency plans are not established.

In other cases, the feedback from a disaster is insufficient to help draw lessons for risk assessment, the design of prevention measures, or emergency planning. In the case of emerging systemic risks, it is particularly important to evaluate the extent to which the occurrence of hazard and propagation of damage conformed to expectations and the extent to which they generated new information. More specifically, the occurrence of hazards could lead to an overhaul of the assumptions underlying risk assessments, and bring to light fundamental changes in the risk context. However, if detection and communication of such issues have not been planned for *ex ante*, it is possible that critical information will be lost during the emergency phase. The various components of regulatory regimes therefore need to be evaluated systematically as circumstances or the state of knowledge evolve.

3.3. Favour flexible risk policies

Third, consistency can be better preserved over time by avoiding decisions that might prove too costly to change, especially when they are made with imperfect knowledge of the risk issue. More precisely, risk management decision makers need to recognise the value of keeping options open. This may entail early action, for instance preventive measures to forestall an irreversible change in the environment until its consequences are adequately understood. Conversely, it may lead to the postponement of preventive action, for instance in the case of the development and application of a technology whose risks and benefits are not yet properly measurable.

To heighten temporal coherence, policy makers need to favour flexible – *i.e.* reversible – decisions, with a particular view to enhancing the process of acquiring information and improving knowledge. Flexibility of risk management options is especially important in the case of emerging risks, where uncertainty and the potential for progress in scientific knowledge are high, but also in the case of risk situations that have been experienced for a long time and that might be substantially altered by external factors.

Specific recommendation for further OECD work

It is proposed that the OECD carry out a series of (voluntary) country reviews on risk management. The reviews could encompass the various elements involved (assessment, prevention, emergency management,

recovery management) in the major risk areas considered in this report. It would focus on the consistency of related policies and on their ability to deal with the challenges, present and future, created by emerging systemic risks, and identify opportunities for improvement and best practices. Quantitative data, aimed at providing a comprehensive picture of risk issues and their management, would be collected. The reviews would start with a pilot study of a limited number of countries, again on a voluntary basis. Ultimately, most or all member countries could be covered, opening the possibility for an OECD Outlook on Risk Management.

2. Developing synergies between the public and private sectors

The roles of the public and private sectors in risk management have been shifting in the past decades, in particular as a result of regulatory reform and privatisation. Direct government control over risk-generating activities has gradually been giving way to softer forms of regulation, while citizens' expectations in terms of risk control seem to have risen. At the same time, the private sector is itself nowadays faced with many of the challenges identified in this report – for instance, when it comes to providing adequate information to the public and gaining trust.

Managing risks efficiently requires adapting to this changing situation and taking advantage of the new synergy potentials between public and private sectors. More generally, direct intervention through safety regulations and other command-and-control schemes is only appropriate when government has a better knowledge of risk than other actors. Centralised risk prevention strategies are increasingly faced with the difficulty of monitoring all decisions and actions inside a complex system, and with the tendency of individuals and organisations to preserve degrees of freedom. Every day in OECD countries, individuals, corporations and local authorities are faced with new risk situations they have to manage without the help of formal instructions. Three broad areas of action are recommended in that respect: getting the incentives right; enhancing the role of the private sector in risk management; and addressing the issue of scale through co-operation and diversity.

Recommendation 4: Get the incentives right

Efforts in favour of risk prevention can be less than optimal in a market economy because of externalities (i.e. the costs of risk-generating activities being borne by others) and short-term reactions to competitive pressures and opportunities. It is thus necessary that governments, in parallel with the process of regulatory reform, enhance risk prevention through three types of action: first, correct the disincentive effects of public policies; second,

internalise to the extent possible the costs of risk-generating activities; and third, clarify roles and responsibilities in ensuring safety.

4.1. *Correct the disincentive effects of public policies*

In some areas, tax and subsidy systems create disincentives to risk prevention. Subsidies supporting intensive practices in agriculture, for instance, have been found to be partly responsible for pollution and food safety problems. In many such cases, public authorities are pursuing other objectives and so tend to overlook the negative impacts of policy in terms of increased risks. In the same vein, land-use and transport planning can play a major role in alleviating or aggravating the costs of disasters through their impact on individual behaviour (e.g. in the case of flooding).

Taking account of the consequences measures could have for risk behaviour should become a permanent element of policy design in all parts of government. Where evidence is available, these consequences need to be accounted for in a comprehensive cost and benefit analysis of the proposed policy.

4.2. *Internalise the costs of harmful activities*

As command-and-control modes of risk management lose momentum, an effective way of ensuring that risks are adequately handled by the private sector is to have the cost of damage borne by those who cause it, in accordance with the Polluter Pays Principle (“Risk Imposer Pays”). Most countries have modified tort law in this direction in recent years, notably with the introduction of notions of liability for environmental damage. In other cases, however, liability laws and insurance schemes have been modified with the sole aim of providing better compensation to victims, whether damage is due to neglect or not. Future evolution in tort law should therefore pay increased attention to creating adequate incentives for risk prevention in tort law.

Another concern raised by recent developments in national tort laws is the uncertainty related to so-called development risks, whereby a producer could be held liable for damage caused by their activity even if the damage was not foreseeable at the time they embarked on the activity. In a number of recent cases [e.g. the deterioration of the ozone layer caused by chloro-fluoro-carbons, or bovine spongiform encephalopathy (BSE)], the hazardous nature of a private business was established *ex post* in large part thanks to publicly funded research. These cases point to the need for clarification of the legal frameworks concerning a producer’s liability and their responsibilities in continuing risk assessment in cases of uncertainty.

Finally, moral hazard issues need to be better addressed. When liability is limited – notably by the status of corporations – mandatory insurance should be the rule; public and private insurance schemes should adapt policies to risk

profiles more closely. When such differentiation conflicts with social or ethical objectives (in the case of flood victims, for instance), compensation schemes should preserve incentives for risk prevention.

4.3. Clarify roles and responsibilities in safety

Changing regulations and privatisations have given local authorities and corporate management more of a say in defining, implementing and enforcing safety goals and norms. However, roles are not always clearly defined or responsibilities clearly established between operators, their contractors and enforcement authorities. According to *ex post* investigations, this lack of clarity has been partly responsible for several large-scale accidents in OECD countries in the past years.

Precisely defining respective duties and liabilities could substantially strengthen incentives for safety improvements in numerous sectors of activity. This is, for instance, one of the major aims of the ongoing reform of the UK railway regulation system.

Recommendation 5: Enhance the role of the private sector in risk management

At a time of rapidly changing technologies, practices and market conditions, a major challenge for public authorities is to define, apply and enforce appropriate regulations. Co-operation with the private sector could make this task easier and increase regulatory effectiveness.

5.1. Encourage self-regulation as a complement to traditional control measures

Self-regulation should be encouraged as a useful complement to traditional control measures. A number of large-scale accidents in the past few years show that while risk regulations exist, they may be poorly adapted to rapidly evolving operational conditions, or may simply not be implemented. The long-term costs of such accidents for the operators themselves should make it clear that effective regulations are desirable for all parties.

Developing a dialogue between regulators and operators could therefore help to ensure that rules and norms are appropriate, and encourage their application.

5.2. Work in closer co-operation with private industries dealing with risk

Public regulators could better exploit synergies and work in closer co-operation with private industries dealing with risk – standard-setting institutions and certification companies, as well as insurers and reinsurers.

Tools of risk and safety assessment have been developed by standard-setting institutions and implemented in a variety of industries in recent years,

as shown by the impact of ISO certification on safety management in corporations. Public/private co-operations can make use of such tools, complemented when necessary by liability law. For instance, if safety norms are necessary but not sufficient for ensuring an optimal level of care, tort law can hold an injurer liable for damage even if they were in compliance with the norms.

There is also tremendous potential for co-operation with the insurance industry, which could for example make more frequent use of public regulations (such as building codes, industrial safety norms, etc.) as a cost-effective way of differentiating risks. In turn, the insurance industry could play a significant role in implementing and enforcing those regulations, thus sharing the public sector's burden.

Recommendation 6: Address the issue of increasing scale through co-operation and promotion of diversity

Scale and concentration are serious challenges to risk management policies. Even in affluent OECD countries, the occurrence of various hazards can – and repeatedly does – overwhelm society's management capacities, be it in terms of disaster response, rapid recovery, or financial coverage of losses. This is particularly true when a critical infrastructure is affected, exacerbating economic and social repercussions. A threefold strategy could address the issue of scale: first, promote diversity; second, increase the scale of society's response capacity; and third, design adequate risk transfer mechanisms.

6.1. Promote diversity through a range of public policies

Diversity is a natural response to risk, since it decreases society's vulnerability to a particular hazard. Public authorities have a variety of means for promoting this response. Infrastructure policy, for instance, could begin to consider vulnerability as a cost factor attached to concentration. Increasing concentration should therefore be submitted to systematic scrutiny from a risk standpoint with, when needed, rigorous requirements with respect to additional safety guarantees.

Public procurement policy and competition policy are other areas where governments could effectively support diversification and combat the heightened vulnerability that may be associated with concentration.

6.2. Improve mobilisation of resources to increase society's response capacity

Increasing society's response capacity is often a matter of better mobilising existing resources to confront larger, more complex, and sometimes new issues. Participation of governmental services and agencies, private partners, and non-governmental organisations in disaster relief and

emergency management is a case in point. Improved planning and co-ordination among these various actors could go a long way toward developing societies' capacity for reducing the impact of disasters.

It is probably preferable that efforts to enhance the effectiveness of co-operation begin in the context of known hazards and emergency situations, before being extended to unknown configurations. Adding new management layers and structures to confront emerging risk situations when existing structures do not yet deliver their full potential would no doubt prove less efficient.

6.3. Design adequate risk transfer mechanisms

The capacity of risk transfer mechanisms to deal with emerging systemic risks deserves special mention. The increase in losses due to natural, technological, health-related, and now terrorism-related disasters has raised questions about the ability of the insurance industry to continue covering these risks. Multi-pillar risk-sharing mechanisms involving insurers, reinsurers, pooling structures, capital markets and possibly governments need to be designed in response. In some extreme cases (*e.g.* catastrophic terrorism, earthquakes affecting megacities), in view of the interdependencies between national capital markets and insurance industries, financial loss due to major risks could become a global issue necessitating a co-ordinated international response.

Specific recommendation for further OECD work

The OECD should investigate the issue of capacity-building toward the financial response to large-scale disasters. This work would review the various instruments of risk transfer, including insurance and reinsurance, insurance pools, compensation funds and catastrophe bonds. It would analyse the issue of sufficiency of national capacities; the need for and features of an international layer adding to national schemes; the role of governments in that context; and the merits and limits of various forms of international co-ordination. It could build on the findings of ongoing work on the insurance aspects of catastrophic terrorism, as well as on the Nuclear Energy Agency's experience as the depository of two international conventions on nuclear third-party liability.

3. Informing and involving stakeholders and the general public

One of the crucial aspects of the heated debate that has taken place in the past fifteen years between proponents of a "social" approach to risk management and those favouring a "scientific" approach pertains to the role of government in the public's perceptions of risk. The former school of thought

focuses on the value-laden nature of risk, and advocates a representative form of government that would follow and reflect the public's preferences with respect to risk management. The latter emphasises the need to allocate rationally society's limited resources for risk management based on objective assessments, and advocates a preference-shaping form of government that would correct the public's "misperceptions" regarding risks.

The challenge for governments is to strike the right balance between these polar models. In other words, they must avoid founding risk management policies solely on experts' evaluations or, alternatively, on reactions of the public, and instead work with both experts and citizens to prioritise and regulate risks based on sound reasoning. Recommendations for action in this respect fall into two categories: developing risk awareness and safety culture; and enhancing dialogue and building trust.

Recommendation 7: Develop risk awareness and a safety culture

A society's safety culture is a determining factor in the way it prevents hazards, prepares for their occurrence, minimises their impact and recovers. Awareness of risk issues and commitment to their handling among people and organisations is a prerequisite for efficient risk management in an open society. Promoting a safety culture requires getting the various actors in society to understand the different facets of major risks, without neglecting one aspect or overemphasising another. The development of a balanced understanding of the scientific and social aspects of risks and benefits is also essential. It is, therefore, a matter of dialogue and exchange between risk managers and local actors.

Two categories of action are recommended with regard to the promotion of a safety culture: first, educating, training, and communicating; and second, adequately articulating self-organisation and centralised risk management.

7.1. Develop safety culture through education, training, and communication

Very often, the apparent neglect – or, on the contrary, the excessive concern – of the public with regard to a risk represents an inadequate articulation of the risk/benefit balance or its scientific and social aspects. In many risk areas, ranging from floods to neglected infectious diseases, the public needs to be better informed or updated on a hazard, on means of avoiding it or mitigating its consequences, and on individual responsibilities in risk prevention. However, the development of a safety culture requires information not only to be accessible to local risk managers as well as to laymen, but also to be usable and actually used by them.

The media, schools, hospitals, local public authorities and non-governmental organisations can play important roles in this respect. In some

OECD countries, disaster preparedness has long been an integral part of civil education in schools. Others organise large public events related to risk prevention and emergency response (e.g. Japan's Disaster Day).

Adequate risk communication is also of particular importance, notably during the window of opportunity opened by an accident or a disaster. Disasters are followed by a period in which the attention of the public and the media are at their highest. The experience of harm forces society to re-evaluate risk and the way it is managed. The origins and consequences of a disaster need to be investigated, analysed and communicated to the public in the form of recommendations for the future before this period of heightened attention ends.

7.2. Articulate self-organisation and centralised risk management more fully

Providing information is adequately carried to local risk managers and the public, principles of community self-organisation may provide important pointers for the future of risk prevention and emergency management. Learning processes and voluntary co-ordination inside networks may provide highly effective ways of developing awareness, preparedness, and responsiveness to hazards. At the same time, however, more centralised modes of risk management remain necessary to ensure coherence of structure and unified leadership.

Adherence to a number of principles can help establish the right balance between centralisation and decentralisation in the handling of risks. First, consensus has to be established among the organisations involved, with each entity understanding the purpose of the network, its own role, and that of the other entities. Second, a leader has to be identified and acknowledged for their legitimate authority and expertise, and has to operate through a central co-ordinating mechanism. Third, the organisations have to maintain frequent contact and interaction in normal times, especially through periodically arranged joint exercises, since establishing consensus and authority structures during the onset of a major disaster is extremely difficult.

Recommendation 8: Enhance dialogue and build trust

In today's world, it is impossible to handle risk without the essential ingredient of trust. When the public does not feel that trust, there tends to be overreaction in the form of panic and stigmatisation of certain products or technologies – indeed, a heightening of risk. The BSE crisis in Europe in the 1990s demonstrated that lost trust can drive a wedge between the “rational” risk policies promoted by experts and the expectations of the public. It also showed that the costs to follow for risk authorities are, in any case, bound to be formidable. Risk management services and agencies should

therefore make generating and reinforcing trust one of their primary aims. That will mean building a constructive dialogue between risk authorities and society – all stakeholders should feel that their legitimate concerns receive attention in the decision-making process. Four lines of action can contribute to building this bridge and improving relations. First, ensure credibility of risk assessments; second, develop deliberation processes between risk managers, experts and stakeholders; third, even in emergencies, favour transparent and consistent risk communication; and fourth, identify and effectively correct the causes of failures so as to reassure the public.

8.1. Ensure the credibility of risk assessments

To be credible – thus, to generate the citizens' trust – risk assessments need to have clear and solid grounds, be effectively communicated to the public, and have no link to policy decisions. Institutional arrangements can help establish this credibility. For example, assessment can be entrusted to independent advisory agencies whose personnel are appointed solely according to criteria of competence and integrity and whose decisions are, if not necessarily followed, at least respected by policy makers. In recent years, such bodies have been created or ameliorated in several OECD countries, notably in the field of food safety. Another solution is to systematically submit scientific assessments for peer review – providing the review process is rigorous and transparent – and to make the information available to the public. Such is the procedure followed by the Office of Management and Budget in the United States.

Institutional changes undertaken to reinforce credibility should properly reflect the particularities of the risk category and the country in question. And they should in no way attenuate or mask the responsibilities of policy makers. It must be clear that scientific assessment is only one input among others in decision making, and that the quest for the best scientific expertise should not serve as an excuse to delay, let alone preclude, action.

8.2. Develop processes of deliberation between risk managers, experts and stakeholders

Risk decisions involve a variety of actors, from public officials and experts to interested and affected social groups, each of which might represent a different sensitivity to the various dimensions. Analyses leading to risk management decisions must therefore pay explicit attention to the range of standpoints, in particular in situations with a high potential for controversy. This is often best done by involving the spectrum of participants in every step of the decision-making process, starting with the very formulation of the problem to be analysed.

Deliberative procedures bringing together the stakeholders in a risk issue have been devised and developed in recent years in diverse risk areas and countries, and the experience has yielded a number of lessons and tools. When involving stakeholders, risk managers have to avoid putting a premium on well-organised private interests to the detriment of the general public. Deliberative procedures can be adapted to the specificities of the risk issue, provide lessons in risk communication to the broader public, and be based on objective and scientific assessment. At the same time, however, they have to express clearly the limits of scientific knowledge, the underlying assumptions and the uncertainties. Methods of decision analysis can help determine the role of facts, uncertainties and values in differing risk evaluations, and lead to balanced and efficient decisions.

Foundations such as these now need to be applied more broadly.

8.3. Even in emergencies, favour transparent and consistent risk communication

In periods of crisis, trust cannot be used as a pretext for lack of transparency or adopting paternalistic attitudes towards the public. In OECD societies today, withholding information on major risk issues is generally not practicable over long periods of time, and can be extremely costly in terms of lost public confidence. Only in some exceptional cases where the physical protection of people is involved (*e.g.* terrorism) can a temporary lack of information be accepted by society.

On the other hand, the release of information on risk should be managed in an effective and timely manner. Risk management authorities need to be aware of the social dynamics of risk issues, and of how information can be framed and used by specific stakeholders. All agencies and services dealing with risk communication need to be able (notably through training) to provide a complete and objective view of risk to the public.

8.4. Identify and correct the causes of failure to restore trust

In addition to transparency and effective communication, corrective – and possibly precautionary – measures are necessary to prevent damage from spreading, and to restore the public's trust. In many cases in the past, reactive and inadequate announcements aimed at reassuring the public have only increased confusion and entailed additional costs. Therefore, such measures have to be planned for and implemented in a timely fashion after a hazard occurs, based on an accurate understanding of the actual situation and of the public's perception of it.

Finally, denial should have no place among risk managers' attitudes. One way to ensure this is to avoid the systematic search for scapegoats,

i.e. apportioning blame on the basis of a superficial examination of responsibilities in the aftermath of disasters. Some OECD countries have begun according more room for manoeuvre to independent bodies investigating accidents and disasters. The generalisation of such professional services is warranted as a means of detecting the real origins of risk management failures, be they individual, collective or organisational, and of restoring public trust.

Specific recommendation for further OECD work

The OECD should explore the development of instruments for assuring the flow of accurate and timely information to governments and stakeholders at national and international level, as well as instruments of reactive and proactive intervention. Particular attention should be devoted to finding means of improving communication with stakeholders and the general public, and strengthening their involvement in the various stages of the risk management cycle. In addition, in specific areas like food safety, nuclear safety, natural disasters and possibly cyber-crime prevention, it is recommended that the various aspects of risk communication and public participation in decision making be reviewed.

4. Strengthening international co-operation

A significant feature of emerging systemic risks is their increasingly international, often global dimension. This holds not only for many of the risks themselves (*e.g.* infectious diseases, terrorism, extreme weather conditions), but also for the context in which they are evolving (*e.g.* growing transborder movements of people and goods, global climate change) and for the solutions available to risk management.

Co-operation among countries, therefore, is of major importance. It can be implemented in various forms and at different levels. In a rough progression from less to more intensive engagement, international co-operation may range from simple exchange of information on and knowledge of the current situation, through agreements on common definitions, norms and objectives, to co-ordination of national initiatives and, finally, to joint action. There can be no doubt that over recent decades considerable progress has been made at all these levels in many areas of risk management. The body of this report has enumerated many such examples. Nonetheless, the report has identified numerous cases where further progress is desirable. The recommendations that follow categorise these cases in three clusters: knowledge transfer, collaboration on monitoring and surveillance tools, and creating broader co-operation frameworks.

Recommendation 9: Achieve better sharing of knowledge and technologies across countries

New technologies – in particular, high-performance and widely distributed computing, satellite observation and imagery, mobile communications and the Internet – hold out the prospect of significant benefits to risk management if their potential contributions can be realised. But they face a number of obstacles: uneven distribution of specialised knowledge and technological capacities among countries (e.g. access to satellite networks, geographic information systems, epidemiological expertise); lack of the requisite technical and organisational skills to benefit from them; insufficient funding; and a frequent inability to furnish practitioners with data and information that are comprehensible and usable.

9.1. Reinforce existing co-operative structures

A wide range of international co-operative platforms for sharing knowledge and technologies already exist. The way has been led primarily by organisations and sectors with long traditions in safety assessment, inspection and information communication (e.g. UN Disaster Assessment Committees, the OECD Nuclear Energy Agency and chemicals programme, WHO).

In a number of areas, however, such structures would benefit from further strengthening. This is notably the case with relief efforts directed to regions stricken by natural catastrophes, where poor co-ordination of information and logistics frequently leads to an over- or under-response to the disaster. It also applies to the urgent need to facilitate global flows of data and knowledge among users and providers of disaster management information. Useful initiatives such as the Global Disaster Information Network (GDIN) have emerged in recent years, but need to be strengthened and expanded to meet the growing demands of the next decades.

Finally, in yet other areas, completely new structures for international co-operation may have to be explored, for instance in meeting the global challenges posed by the risks of bioterrorism and cyber-crime.

9.2. Expand information- and technology-sharing agreements to developing countries

Improving the diffusion of knowledge and technologies to the less well-equipped populations at risk – most notably perhaps in developing countries – is clearly a humanitarian objective, but it also serves to reduce the vulnerability of economies and societies more generally. International co-operation is a vital tool in this regard. It should be remembered, however, that

the gap in capacity to manage major disasters between advanced and developing countries is considerable.

OECD member countries and international organisations could make an important contribution to closing that gap by exploring further the possibilities for gradually expanding existing information- and technology-sharing agreements to include key players among transition and developing countries. One example is ongoing co-operation in the fields of nuclear safety research and nuclear legislation with Central and Eastern European countries and Russia, under the auspices of the OECD Nuclear Energy Agency.

Recommendation 10: Enhance international systems of surveillance and monitoring

The previous chapters of this report have highlighted the necessity for effective, widely cast surveillance and active monitoring of a diverse range of hazards. When, in this highly interdependent world, the lack of appropriate surveillance structures leads to risks going undetected, or being wrongly assessed or inadequately managed, the chances of contagion or amplification in such areas as health, radiation, terrorism etc. are greatly increased. Several initiatives already in place at international level provide useful leads as to the direction in which actions to strengthen surveillance and monitoring internationally could be encouraged. The fields involved include nuclear energy, telecommunications, chemicals, infectious diseases and antimicrobial resistance. Initiatives in new areas are also emerging.

10.1. Build effective surveillance into pre-existing domestic and international structures, to provide decision makers with usable information

Effective surveillance is key to the timely assessment, prevention, mitigation and limitation of hazards. For many emerging systemic risks, such as infectious diseases and large-scale terrorism, it is unlikely that completely new surveillance systems will be needed. (One notable exception, near-earth objects, is mentioned below.) As the report indicates, there is a widespread preference for building on pre-existing domestic and international structures. However, existing surveillance and monitoring systems do reveal deficiencies – inadequate reporting, lack of appropriate advanced equipment, low levels of technical skills, incomplete coverage of certain regions or types of risk. And ultimately, the identification and tracking of emerging risks can only be as good as the quality of the surveillance systems in place. A further point is that these existing systems generally consist of networked national or regional establishments, so that the integrity of the overall surveillance depends vitally on the quality of the individual participating establishments.

Many technical information tools are now available to decision makers; what is important is to ensure that the type and timeliness of the information supplied matches their needs. Emergency exercises are useful in this respect. They can help clarify these needs, serve as a training ground for the individuals who will be responsible in case of an emergency, and test-run local, regional, national and international plans.

Apart from relevance, the density of information (geographic, demographic, hazard assessment, uncertainty, etc.) that should be presented on maps to be used by decision makers is a key issue. This information density should be chosen to facilitate rapid assessment of a situation, and should correspond to the types of decisions that will be necessary at that moment: dispatching emergency response units, deciding on countermeasures, asking for international assistance, etc.

10.2. Co-ordinate efforts to strengthen the capacity of public health systems to cope with emerging risks

Improving surveillance and monitoring of systemic risks globally requires action not only at international level but also at national level. Responding to the threat of bioterrorism is a useful case in point. There is broad agreement that ultimately, a country's most effective line of defence against terrorist-initiated attacks in the form of anthrax, smallpox, etc. is a well-organised, well-trained, well-prepared and vigilant public health service. As recent moves by the United States' Center for Disease Control and Prevention (CDC) and the United Kingdom health authorities to improve the monitoring of infectious diseases demonstrate, even highly developed societies need to be aware of their weaknesses in this respect, and to take remedial measures. This requires a well-funded, highly focused effort to bring about the necessary technical, organisational and logistical changes. Such efforts could benefit significantly from regular exchanges of views and experiences among countries on improving public health services' effectiveness in preparing for and dealing with emerging systemic risks.

10.3. Expand the shared use of space technologies for risk surveillance purposes

A number of initiatives have been taken in recent years with respect to sharing space technologies and applications. For instance, in June 2000 the European Space Agency (ESA) and the French Space Agency (CNES) signed a co-operation charter for co-ordinated use of space facilities in the event of natural or technological disasters. Agencies of several other countries have signed in the meantime, and it is recommended that efforts continue to widen participation.

One particular threat calling for this kind of co-operation is that of near-earth objects, a phenomenon that has received considerable public attention in the past few years. Consideration should be given to the kind of international structures that may be needed in order to set up an effective early warning system and to identify possible mitigation measures.

Recommendation 11: Create the frameworks for co-operation

From a broader standpoint, unco-ordinated approaches to risk management may entail considerable costs to the global community. These costs can take the form of underprotection of global common assets due to self-interested behaviour; trade disputes, due for instance to attitudes towards precaution that might conceal protectionist motives; and inefficiencies and gaps in regulation, which may provide unwarranted protection from legal action. International management of a variety of risks requires a policy framework in which decisions are prepared and co-ordinated on the basis of scientific and other considerations, and international texts provide the foundation for dispute resolution.

11.1. Design or expand co-operation mechanisms on a case-by-case basis

Analysis shows that while practices of risk management may vary substantially from one OECD member country to the other, the fundamental principles and aims of risk management have much in common. As shown by the Codex Alimentarius Commission in the sensitive area of food safety, methods and institutional mechanisms can be created that are conducive to multilateral dialogue and to international risk policies based on consensus. Such mechanisms need to be designed or expanded on a case-by-case basis, depending on the specific risk context they address. In general, the objective should not be to impose uniformity in risk management principles and practices, but rather to seek consistency and coherence among the variety of approaches.

11.2. Aim at an internationally consistent assessment of risks

In the first place, co-operative structures need to rely on an internationally consistent assessment of risks. On controversial issues, what is required is advice from an international scientific committee, either existing or to be created, founded on irrefutable expertise and genuinely independent. The International Panel on Climate Change and the International Commission on Radiation Protection can be seen as models for such advisory bodies, in terms of both composition and role. On the basis of such consensual assessments, far-reaching co-operation can be envisaged and binding agreements elaborated when the risk of free-riding makes that necessary.

However, irrefutable scientific information and advice might be difficult to collect for a considerable number of risk issues. In such cases, examples from the past show that effective co-operation can be undertaken on a consensus basis by a small number of countries, and then gradually extended, notably through peer pressure. The Vienna and Paris Conventions defining the international nuclear liability regime, for instance, followed such a process.

11.3. Create partnerships to alleviate the costs of risk reduction

Still, risk reduction co-operation might remain difficult to launch in cases where the costs of action are immediate and the costs of inaction only materialise in the long term. International co-operative structures therefore need not only to promote dialogue but also, through that dialogue, to identify and facilitate solutions. One strategy would be to identify specific cost elements which can be alleviated thanks to dedicated partnerships, *e.g.* aiming at enhancing technological innovations (see also Section 5). Synergy between international negotiations and increased research efforts has proved highly effective in the case of the Montreal Convention regulating the use of CFCs.

Specific recommendation for further OECD work

The increasingly international dimension of major disasters places particular demands on the emergency/civil protection services of individual countries as they face up to the special challenges of cross-border spillover effects from disasters. They need to co-ordinate emergency response measures across frontiers and to learn from emergency management in other parts of the world. It would seem that, apart from some very effective regional networks (*e.g.* in the Nordic area, or the Asian Disaster Reduction Center), few international fora exist for exchanging experience and fostering communication and planning among representatives of those services worldwide. It is recommended that the OECD explore the possibilities for creating such a forum, one that would bring together emergency management specialists from across the member country area and from key developing countries.

5. Making better use of technological potential and enhancing research efforts

As this report has emphasised, while technologies may often be the factor underlying major disasters, they are also without question a key source of disaster management tools and solutions – for monitoring and surveillance, prevention, emergency preparedness and response. The potential for new technologies in these areas (*e.g.* satellite observation and imagery, remote sensing, mobile communications, high-performance computing) is enormous,

but realising that potential will require substantial investments, considerable efforts in R&D and training, and determination and innovativeness in establishing appropriate policy frameworks. Three areas for action stand out: the need to create incentives, partnerships and viable business models for the development and implementation of promising new technologies; the need to pay greater attention to technological devices and designs that reduce the vulnerability and increase the resilience of systems; and the need to improve the broader context – regulatory regimes, rights and obligations, public acceptance – so as to facilitate the emergence and diffusion of risk management technologies.

Recommendation 12: Improve support for promising new technologies

The obstacles, real or potential, in the path of new risk management technologies are many and varied. To begin with, there may be an issue of the scale of investment required and concern about low or lengthy return on the investment. Space-based monitoring is a good illustration of these problems. Huge investments are required in the first place to develop and then launch earth observation satellites, and then the appetite of commercial investors is further diminished by the prospect of a lengthy and uncertain cash flow from the venture. Moreover, the use of some technologies that could be highly beneficial to disaster management are restricted to military purposes and may, for institutional or security reasons, not be easily transferable to other uses. A number of other promising new technologies may not come to fruition because of the absence of venture capital, the difficulties of finding a suitable business partner, problems of user-friendliness, or the lack of a sufficiently large market.

12.1. Review the interface between the public-good characteristics and the commercial dimension of key technologies

Governments and the private sector are called upon to make more rapid progress on all these issues. On financing costly space-related risk management technologies, for instance, both should pay attention to what is an increasingly important issue: the changing interface between the public-good characteristics of satellite launchers and space applications, and their commercial dimension. What needs to be explored in particular is whether new business models and new public-private partnerships are required in such endeavours, and what these might look like. Interesting recent models do exist, e.g. Inmarsat and Galileo.

12.2. Create public-private partnerships in support of R&D for selected technologies

It is also urgently necessary to step up the search for public-private partnerships supporting the research and development of many technologies that hold considerable potential for application in disaster management.

Greater use of these partnerships can increase responsiveness to needs and enhance the efficiency and cost-effectiveness of innovation policies. The types of innovation partnerships that should be explored include general research support, informed collaborations, contract research, cluster formation and human resource development.

12.3. Intensify the application of “reconverted” technologies to disaster management

This report has pointed to the increase in the number of technologies that have found their way from a variety of uses to risk management applications in recent years. In particular, many defence and intelligence-gathering tools have been effectively reconverted in disaster management (GPS, remote sensing, synthetic aperture radar systems). However, more could be done to identify dual-use technologies in the military arena and to overcome what may prove to be unnecessary institutional and/or security barriers to their application in areas such as search and rescue or seismic damage assessment.

Recommendation 13: Explore and develop tools that reduce the vulnerability and increase the resilience of systems

Whether the system in question is a critical energy or telecommunications infrastructure at risk from terrorist attack, a public health system confronted with the spread of a known or new infectious disease, or an entire industrial sector threatened by technical disruption of vital supplies, the analytical chapters of this report identify two major strands of vulnerability: structural weaknesses in the physical installations crucial to the system (*e.g.* dams, power generation facilities, hospitals) and “architectural” weaknesses in system design (*e.g.* just-in-time systems geared to a single computer hardware supplier, power transmission lines or telecommunication cables with little or no backup capacity). There is ample scope for action on both counts.

13.1. Detect and reduce structural weaknesses in key installations

The development of new technologies such as remote sensing can make a considerable contribution to risk prevention by providing early warning of structural weaknesses in dams, transport infrastructures and other key installations. Application of these technologies, however, is not widespread and would benefit substantially from efforts to accelerate their diffusion.

Similarly, the upgrading of existing structures needs to be targeted through the development and strict implementation of technical norms. Reviewing and enforcing building codes for old structures in earthquake-

endangered areas, for instance, can go a long way towards limiting the consequences of major disasters.

13.2. Encourage the integration of system redundancies

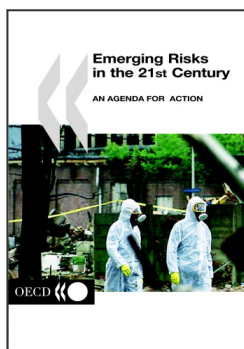
Both public and private actors need to pay more attention to two important resilience-enhancing features: redundancy and diversity in technical systems. This report cites several examples of systems whose in-built redundancies offer vital protection against breakdown or catastrophic damage [e.g. the Internet, the US Federal Aviation Administration's Air Traffic Control System (ATC)], but also numerous examples of costly disruptions – in particular to critical infrastructures such as telecommunications and energy transmission – whose severity could have been greatly lessened by the presence of redundancies, backup systems, etc. Clearly, governments and regulators have a role in providing the appropriate foundation for integrating such system redundancies, for instance through the introduction of emergency infrastructure policy frameworks where these do not yet exist, or for increasing levels of redundancy to match greater levels of risk (even though the initial cost may be considerably higher). But there is also scope for private sector initiative, as demonstrated by the recent moves by Asian telecommunications companies (Arcstar) to improve disaster recovery, and by the work of the American Network Reliability and Interoperability Council to maintain telephone, cable and Internet networks in case of a major disaster. In addition, there is a strong case for augmenting diversity in the use of hardware and software for critical infrastructure systems – a move that both the public authorities and corporations could encourage individually and collectively through, e.g., public procurement policies that take more account of the potential cost of major system failure.

Specific recommendation for further OECD work

It is recommended that the OECD use the opportunity offered by the planned work on the commercialisation of space applications to explore, together with governments, space agencies, launchers, satellite operators and end-users, 1) the long-term prospects for space-based applications such as earth observation, meteorological monitoring, navigation and tracking, telemedicine, tele-education and so on, and their potential utility to risk management, and 2) the need for new business models and possibly public-private partnerships to develop those applications in the interests of risk management.

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