



Workshop report

Public Sector Governance of Emerging Risks

Hallmarks and drivers

Workshop report

May 2013

Abbreviations

AGP	antibiotic growth promoter
AMR	antimicrobial resistance
CSF	Centre for Strategic Futures (Singapore)
DANMAP	Danish Integrated Antimicrobial Resistance Monitoring and Research Programme
DARPA	Defense Advanced Research Projects Agency (USA)
IASB	International Association of Synthetic Biology
iGEM	International Genetically Engineered Machine
IGSC	International Gene Synthesis Consortium
NSF	National Science Foundation (USA)
RAHS	Risk Assessment and Horizon Scanning (Singapore)

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Preface

In late 2011, the Treasury Board Secretariat of Canada asked IRGC to develop a project to provide input to and support their efforts to improve the management of emerging risks. This was a natural fit for IRGC, linking with its efforts to develop guidelines for emerging risk governance. IRGC invited representatives of other governments to join the project, so that each could review their own and others' processes and outcomes to benchmark their own practices. The development of a number of case studies was proposed, to illustrate past or current practices in the management of specific emerging risk issues.

The following report summarises the discussions at two workshops held in March and September 2012 and the recommendations that were derived from careful analysis of the case studies. We hope that the readers will find it of interest and look forward to receiving feedback.

Introduction

Developing good practices for emerging risk anticipation and early response

Most organisations with a mature understanding of challenges related to anticipating and dealing with emerging issues have a relatively clear idea of what they would like to achieve:

- Shared views on objectives, while also allowing contrarian views to be listened to and taken into account;
- Transparency and sharing of information, as necessary without compromising specific objectives;
- Accountability and responsibility, both in the short-term and for long-term objectives;
- Ability to deal with long-term issues, despite individual motivations for short-term rewards.

The challenges of improving anticipation of and early response to emerging issues have often been analysed in terms of “need to know better” and, more generally, “what needs to be done”. However, offering guidance on what to do is only the first step – what remains problematic for many organisations is deciding how to do it. There are many trade-offs that organisations struggle to resolve in a sustainable manner, many of them being related to long-term versus short-term or public versus private interests.

Risk management in government

A number of governments, such as Canada and the UK, have developed frameworks for the management of risks that may have an effect on their normal functioning and budgets. These frameworks provide general guidance on the principles of risk management to support government organisations to develop their own risk management processes. Such frameworks include identification and analysis of risks that may affect the pursuit of their objectives, as well as on-going review and improvement of risk management practices. Most organisations intend to improve internal processes for risk management as well as to consider risk management in relation to the wider environment in which the organisation functions.

These frameworks provide guidance to risk assessment, management and communication, and are moving towards enhanced risk management, including consideration of the needs to:

- Improve organisational and societal resilience;
- Adopt proactive management approaches;
- Establish stakeholder confidence and trust;
- Strengthen reliable decision-making and planning;
- Provide practical advice (beyond principles and concepts); and
- Focus attention on tackling organisational risk by identifying and treating both external and internal influences and factors that give rise to that risk.

However, few are (yet) designed to also be anticipatory of potential emerging risk issues.

Management of emerging risks

IRGC has undertaken research to identify how large private and public sector organisations, including national public services, are effectively managing emerging risks. Through its research, IRGC has identified hallmarks and drivers of organisations that are succeeding with emerging risk identification and subsequently pursuing action on early risk response measures in order to improve proactive management practices. Through case study assessments, an expert workshop and further analysis, IRGC has analysed the hallmarks and drivers that contribute to efficient results in managing emerging risks, including policies and incentives, as well as how organisational and management behaviours are encouraged and sustained to build a culture of proactive risk management. The work has explored how, in certain cases, risks were (or were not) adequately managed and has tried to establish the hallmarks and drivers, factors and incentives that were in place (or not) and what behaviours were encouraged to lead to effective or ineffective risk management.

We hope that this initiative contributes to the development of a body of empirical research that supports the evidence that taking proactive measures to identify and respond to emerging risks can lead to results. We also hope that it will lead to transferable findings and concrete examples of good practices in managing emerging risks that could be used in large organisations (government or public sector agencies). Finally, we hope that it will prove to be useful for organisations willing to benchmark their risk management practices against international experiences.

We anticipate that the outputs and lessons learned from this research can contribute to furthering public policy and performance discussions both within national and international contexts.

Creating the right conditions for emerging risk management

For governments that have established risk management policy norms, procedures, guidelines and practices across agencies, including risk management is not a separate issue, but is intrinsically connected with decision-making and setting the right conditions that allow for the “right thinking” in an institution.

This document presents, summarises and illustrates hallmarks and drivers of governance practices for emerging risks. They can be regarded as conditions for success that policymakers are advised to consider in identifying what might be “missing” in the work done by technical experts, whose function is to analyse and make recommendations about possible uncertainties or new threats that may affect governments and their countries.

Executive summary

This report identifies, describes and illustrates hallmarks and drivers of effective public sector governance of emerging risks.

For this purpose, IRGC and selected experts have prepared six case studies on how emerging risks have been or are identified and managed by public sector institutions. These cases were compared and discussed in a collaborative workshop with government representatives and scientists. The six case studies are:

- Proactive and adaptive governance of emerging risks: the case of DNA synthesis and synthetic biology (by Kenneth A. Oye), hereafter referred to as the **synthetic biology case**;
- Interaction of social and economic risk (by Darryl Jarvis, Johannes Loh, Tim Hilger), hereafter referred to as the **interaction case**;
- Combatting the risk of antimicrobial resistance (AMR) in animals for the benefit of human health in Denmark (by Peter R. Wielinga and Jørgen Schlundt), hereafter referred to as the **AMR case**;
- Managing the risk of ageing infrastructure (by Richard G. Little), hereafter referred to as the **infrastructure case**;
- Risk governance of food supply chains (by Kees Burger and Jeroen Warner), hereafter referred to as the **supply chains case**; and
- Migration as a policy response to population ageing (by George W. Leeson), hereafter referred to as the **migration case**.

These cases have provided background and illustration of nine dimensions that represent crucial elements of good governance of emerging risks. These nine dimensions (or hallmarks and drivers) are:

1. **Developing transparency**
2. **Assigning accountability;**
3. **Including relevant stakeholders;**
4. **Integrating different risks, impacts, departments, public-private partners;**
5. **Convincing methods for monitoring and evaluating management options;**
6. **Prioritising risks;**
7. **Determining the right timing;**
8. **Ensuring flexibility and adaptability; and**
9. **Communicating.**

The case studies were then analysed according to these nine dimensions and the hallmarks and drivers of good governance were elaborated. The analysis revealed differences between the case studies to the degree that some demonstrated an extremely well developed governance structure. Other case studies revealed, for various reasons, a less developed governance structure.

One must acknowledge that it is very difficult to achieve effective outcomes for all of the nine dimensions. Trade-offs have to be made, and these trade-offs have to be made transparent. The trade-offs should be defined at the beginning of the risk governance processes, communicated to all affected parties, and monitored as to whether adjustments have to be made later in the process. Trade-offs are necessary to create a risk profile which captures the most important aspects of risks that matter to the organisation. Risk profiles are used to define the risk appetite of an organisation, i.e. the willingness of an organisation to take or tolerate predefined levels of risks. An alternative strategy is to invest in risk resilience, which enhances the organisation's capacity to cope with surprises. However, resilience can be economically ineffective as investing in being prepared for highly unlikely events does not pay off if gains and losses are assessed over time.

1. Transparency can be divided into procedural transparency (the governance process itself) and substantive transparency (information on the emerging risk and its handling). Transparency is necessary for effective communication, but does not replace communication: a secretive process will make communication fail, however, transparency alone is insufficient as the rationale of the process will not be conveyed. Transparency is closely coupled with accountability and if different actors are

involved transparency must be apparent for all of them. Further, transparency relates to both the availability of published material and its comprehensibility.

2. Accountability must be separated from legal liability. Lacking accountability is an invitation to crisis, however, ascribing accountability to an actor places a major burden on that actor, thus incentives are necessary to lift the burden to some degree. Accountability is a necessary ingredient to build the trust of the public. Shared accountability, by several actors, in parts of the structural process is easier to carry.

3. For successful inclusion incentives facilitate the involvement of actors. Incentives to become part of a process can be the avoidance of monetary losses, expectations of direct benefits or the possibility of being part of the decision-making process. The degree of inclusion (e.g. number of actors, degree of involvement) has to be adjusted to the specific process. Crucial to the process of inclusion are, however, transparent decisions on *who* to include and *how* decisions are then made, the outcome and how it will be used. If actors cannot foresee what their engagement might lead to it is unlikely they will ascribe to the process.

4. Integration within and between impacts, departments and public and private actors is driven to a large degree by trust between the relevant actors. The more stable and trusted the structure between actors is, the easier it is to include and integrate different aspects. Incentives can help actors to ascribe to the process. Transparency about the structures and procedures of integration is essential.

5. Convincing methods and procedures for evaluating and monitoring refers to methods that enable learning. All interventions to address the emerging threat should be subject to systematic monitoring and evaluation. This is vital as most risks are interdisciplinary, thus the monitoring and evaluation must also be interdisciplinary. Further, it is important to separate the factual assessment (monitoring of results) from the evaluation of the intervention and policy options; the factual assessment should be independent of the evaluation of policy options.

6. To prioritise risks in some situations where risks proliferate through many actors it can be wise to pursue the “follow-the-money” approach to identify areas of excessive profits or money transfers, as often risks manifest themselves through perverse incentives. Further, as causes and consequences of the risk can be beyond the institution’s knowledge and structure, it is crucial to have a person or agency dedicated to exploring risks outside that structure. Scenario building has proved helpful in prioritisation as many aspects can be included if a story is being built around the risk. Scenarios also help in defining the necessary intervention points.

7. Appropriate timing can be achieved by pre-defining intervention points ahead of time through scenario building. Further, appropriate timing needs clearly defined structures of communication to assure a smooth implementation of measures.

8. For ensuring flexibility and adaptability, continuous and independent close monitoring in conjunction with institutionalised feedback loops are crucial to ensure that new scientific, situational or other knowledge is identified, processed and conveyed to the decision-makers. The monitoring relates to *new* knowledge and also to changes in the *relevance* of existing knowledge. An institutional risk culture, which provides a generic vision for all members of the organisation, is needed to be flexible and adaptable in specific processes.

9. Communication is a crucial task in all steps of the risk governance process and also critical for all eight dimensions being discussed in this report. Communication must be tailored to the specific process, the specific risk and the context of the governance process. It must also take into account that for some emerging risks communication changes to *crisis* communication, if sudden large-scale impacts happen. Ad hoc communication is likely to fail and thus generate negative consequences for the governance process, even if all other eight dimensions are well prepared.

PART I: Design of the study and description of case studies

Many governments have designed and implemented "risk management frameworks" as guiding principles for their departments and public agencies. In this report IRGC explores pathways for how governments can become more proactive, effective and efficient in the management of emerging challenges and threats.

The objective of IRGC's project is first to look at real-life experiences and case studies focusing on the hallmarks and drivers that make the difference between successful and failed risk governance approaches. Based on that analysis, the output of the project aims at guiding decision-makers on how to improve their anticipation of and early response to uncertain developments and emerging challenges and threats.

Key challenges include:

- How to organise collaboration between agencies to deal with the interconnectedness and interdependency of most risks which is crucial in emerging risks whose causes and consequences are not fully known:
 - o How to organise interconnection and cooperation between organisations;
 - o How to deal with cross-cutting risks that do not fit nicely into one organisation; and
 - o How to incentivise cross-agency risk management.
- How to organise partnerships with others:
 - o How to involve in the process those who have knowledge, experience and/or resources for improved problem identification and solution seeking;
 - o How to involve the private sector; and
 - o How to implement an effective and efficient "collaborative risk management culture".
- How to move from identifying emerging issues to integrating them in an effective and efficient risk management process:
 - o How to prioritise risks and corresponding actions;
 - o How to set an appropriate risk "appetite" and risk tolerance level for the organisation; and
 - o And, in general, how to link assessment and management.

This paper is the result of a thorough analysis of six case studies, which address the key challenges listed above. The experiences from these case studies – in particular the differences between different governance approaches – provide valuable information about the causes and drivers of an effective and efficient governance approach to emerging risks from the perspective of decision-makers. This report summarises the lessons from this analysis.

The six case studies

A major input to the project comes from six case studies on new or emerging risk issues (or issues which are well known but were managed as "new" or "emerging" issues over the past few years). Expert papers were commissioned by IRGC on each of these topics.

The purpose of the case studies was to highlight past success and failure to delineate lessons for improving strategies. In addition to describing the regulatory and governance regimes, reports on these cases investigated behaviours that led to or could lead to effective risk management or failed risk management. The focus has been on the incentives for effective risk management practices and the structure of the interactions between different departments or agencies to account for cross-cutting risks, as emerging risks often cannot be placed within a single domain.

The analysis presented in these case studies forms the empirical foundation for the recommendations developed in this paper. All case study authors received the same guiding protocol to assure comparability between the case studies. More specifically, the case studies:

- Explore how emerging risks are (or are not) adequately managed given the specific circumstances;
- Explore how some common practices or factors involved (policies, incentives, behaviours) impact upon the efficacy of risk management, which in turn enabled successful identification of emerging risks and corresponding management options;
- Contribute to a body of transferable, practical research and practical lessons that can illustrate how to identify proactive measures and respond to emerging risks;
- Explore how particular organisational and management behaviour can be encouraged and sustained in order to build a culture of proactive risk management;
- Provide practical guidance on how to improve organisational ability to identify and act on emerging risks; and
- Investigate means by which inter-agency and inter-organisational cooperation can be initiated and sustained without creating another level of bureaucratic burden.

The case studies were selected in the following fields:

- Proactive and adaptive governance of emerging risks: the case of DNA synthesis and synthetic biology (by Kenneth A. Oye), hereafter referred to as the **synthetic biology case**;
- Interaction of social and economic risk (by Darryl Jarvis, Johannes Loh, Tim Hilger), hereafter referred to as the **interaction case**;
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Nine points to enhance the capacity of governments to deal with uncertainty and emerging risks

This report proposes nine hallmark and drivers of public sector governance of emerging risk. IRGC considers them as conditions of success. For example, some transparency is needed to address upcoming problems that may require collective action. Each of these points corresponds also to an obstacle that needs to be overcome. For example the lack of transparency should be combatted.

These points can also be considered as many questions that governments should ask themselves when they have to address either a) the *need to deal with uncertainty and anticipate emerging threats*, or b) the *need to act proactively to deal with an emerging risk issue itself*. For example, managers should consider whether their organisation is transparent in its communication.

Questions that derive from these nine points include:

- How to make people accountable (accountability);
- How to overcome the difficulty of including all stakeholders (inclusion); and
- How to introduce adaptability and variability in the regulation of an emerging risk, when regulation needs at the same time to provide stability (adaptive management).

IRGC recognises that it is not possible to deploy emerging risk management strategies and actions that satisfy all nine points. There are inevitable trade-offs that need to be made between them.

1. **Creating transparency** (sharing all assessments and management efforts with stakeholders and the public, except for confidential information);
2. **Ascertaining accountability** on all levels – risk identification, assessment, evaluation and management;
3. **Fostering inclusion**: bringing together actors such as governments (all branches and agencies), private sector (corporations and associations), civil society (NGOs, media, social organisations) and experts;
4. **Striving for integration** among and between different impacts (physical, economic, environmental, social, psychological); departments (health, environment, treasury, labour etc.); and public and private entities (on a continuum between 100% public and 100% private);
5. **Providing convincing methods** for monitoring and evaluating management options and their consequences (evaluation according to effectiveness, efficiency, fairness and sustainability);
6. **Prioritising risks** as there are always more emerging threats than one can deal with. Criteria are needed to distinguish the serious threats from the background noise;
7. **Determining the right timing** – monitoring signals about emerging threats and changing contexts for technological applications; based on these signals appropriate interventions need to be deployed on time;
8. **Ensuring flexibility and adaptability** over time (identifying appropriate intervention points, assuring learning and monitoring, embracing the philosophy of adaptive management); and
9. **Communication** – the necessity to communicate about the need to address emerging risks, the tools and processes used for that purpose, and the data and information collected.

These nine points are closely related to each other, and they often depend on each other. None of the assessment and management approaches, regardless of how well designed they are, are able to meet all nine points to the same degree. It is therefore inevitable that trade-offs between the nine points be assigned. This task requires prudent judgment and leadership. Trade-offs need to be specified according to the mandate of the specific organisation, its risk appetite and its risk profile. They require explicit justification on the basis of the organisation's mission and its basic policy principles.

Roadmap to improved emerging risk management by the public sector

Before taking a closer look at the trade-offs, it is necessary to organise the nine points in a consecutive order. A consecutive order, however, does not imply a hierarchy or an order of importance. Further, there may be good reasons to choose a different order depending on the context and circumstances. However, decision-makers often face the problem of where to start and how to design a roadmap or a plan for a consecutive order of interventions and actions. The following paragraphs provide a possible and consistent step-by-step approach to translating the nine points into a set of consecutive questions (see Figure 1).

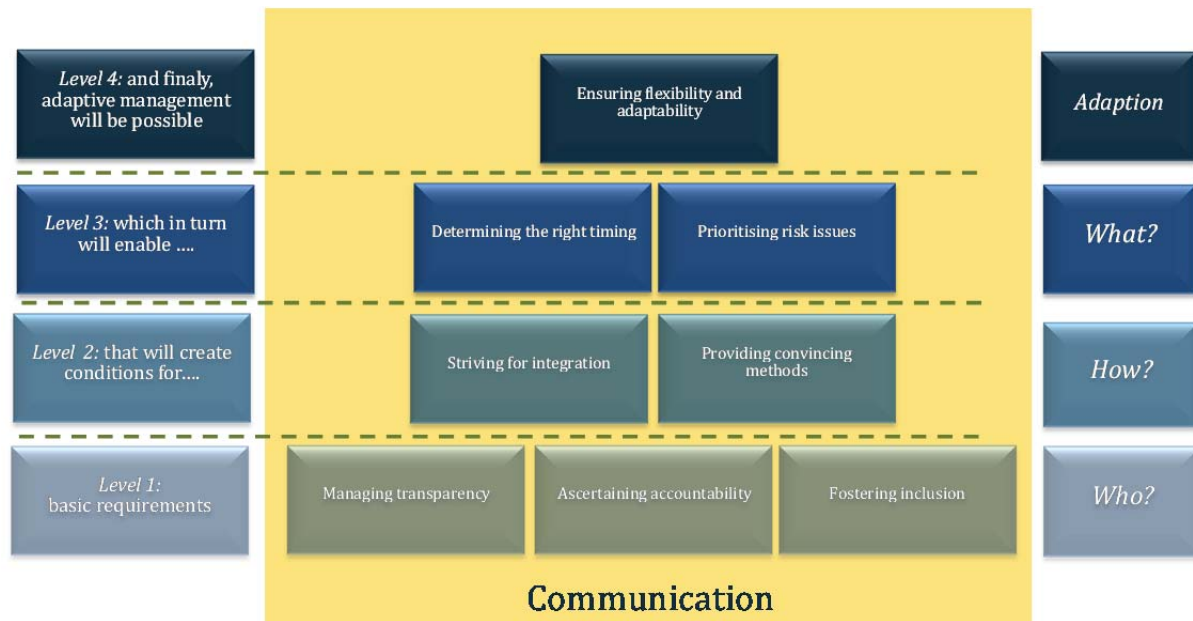


Figure 1. Roadmap to improved emerging risk management by the public sector

[Amend text in lefthand column of boxes – put Level x on its own line, delete colon; Basic (cap B); finally, (add missing 'l'); swap over 'Determining the right timing' and 'Prioritising risk issues' boxes to mirror text order] [These changes need to be made on original file and then the image re-imported]]
→ For the governance of emerging risks addressing transparency, accountability and inclusion are crucial from the beginning (Level 1).

→ Having secured these three major conditions for successful governance, Level 2 includes the creation of adequate structures to assure integration and methodological rigour.

→ Given these structures, Level 3 encompasses the dynamic elements of setting priorities and developing an intervention plan.

→ Level 4 serves the needs for controlling and monitoring providing the building blocks for an adaptive management culture.

→ Throughout the entire process, communication is of fundamental importance. The task of communication must be, as we will elaborate below, tailored to the specific situation.

Trade-offs, risk profiles, risk appetite and resilience

The nine points assist risk managers in designing an appropriate template for dealing with emerging threats and challenges. The main goal is to develop a coherent and sound response to and preparedness for such emerging risks. The points cover the most important aspects to be considered. However, there is no

Example of trade-offs

A vivid example of trade-offs are genetically modified organisms for agricultural purposes. Surveys on the subject indicate that people associate high concerns with the application of gene technology for social and moral reasons. Whether the benefits to the economy balance the cost to society in terms of increased health risks was not a major concern of the polled public. People disagreed about the social need for genetically modified food in Western economies where conventional food grows in abundance; about the loss of personal agency when selecting and preparing food; about the long-term impacts of industrialised agriculture; and about the moral implications of tampering with nature. These concerns cannot be addressed by either scientific assessments of by finding the right balance between overprotection and underprotection. The risk issues in this debate focus on differences between visions of the future, basic values and convictions, and the degree of confidence in the human ability to control and direct its own technological destiny. This is the area where participatory processes are required (adapted from Renn, 2008).

approach available that could reach optimal performance on each of the nine points. As mentioned previously, trade-offs are necessary. They need to be made on the basis of substantive arguments and prudent judgment and communicated to all parties involved.

In some instances **trade-offs** might be self-evident regarding the specific characteristics of the situation. If, for example, a pending threat appears to have a major impact on human health, the economy or the environment and such an impact appears likely to happen soon, risk prevention and reduction has absolute priority over all other goals. Likewise, if a threat seems to be of minor severity and its occurrence is rather unlikely, it may be prudent to delay actions until more information is available. Thus, some situations make one or the other criterion less relevant because of the specific circumstances of the situation.

More often, however, resource restrictions in terms of time and money may be the reason for making “painful” choices. In these circumstances, decision-makers can use techniques such as cost-effectiveness analysis to allocate the resources to the management option that promises to have the highest risk reduction effect. In other fields, private-public partnerships can help to mobilise additional resources, both money and expertise.

Trade-offs should be assigned at the beginning of a risk governance process. Over time these trade-offs should be revisited and adjusted if new information becomes available or new context situations arise. It is advisable to include other agencies and stakeholders in the initial trade-off process, for two reasons: firstly, these external actors may have knowledge or experience valuable in gauging the best trade-offs; secondly, the inclusion of these actors can assist decision-makers in obtaining acceptance for the management measures that are taken and in creating a sense of ownership among those affected by the decisions. Not directly affected groups and individuals should be addressed through communication. They should be informed about the choices that were available, the trade-offs between these choices and the process by which these trade-offs were made.

Assigning trade-offs is an important step in creating a **risk profile** for an organisation, institution or department. A risk profile captures the most important aspects of risk that matter to the organisation. It also helps to focus on those adverse effects that matter most to the organisation. Establishing a risk profile requires clarity about the values, aspirations and norms that form the organisational risk culture. This culture translates into specific objectives, safety goals and procedures on how to achieve them. These principles, norms and procedures should be already in place before the risk situation occurs. They should be well developed routine operations so that they can be quickly and efficiently applied if the organisation faces a sudden crisis or becomes aware of a pending threat.

A risk profile also helps to determine the degree of **risk appetite**. This term describes the willingness of an organisation to take or tolerate pre-defined levels of risks. The willingness to take or tolerate risks differs from one organisation to another depending on its mandate and risk culture. Risks also create opportunities. Thus, risk appetite characterises the trade-off between risks and opportunities.

As an alternative to deal with each emerging threat separately, one can opt for the strategy of **resilience**. Resilience enhances the capacity of an organisation to cope with stress and recover quickly when exposed to a hazard. The more resilient an organisation, the better able it is to cope with surprises. However, one should be aware that investments in resilience are suboptimal in economic terms compared with expected value approaches or risk-benefit balancing. Taking precautionary measures for highly uncertain events does not pay off if gains and losses are assessed over time (expected value concept). However, taking the resilience approach is highly recommended if an organisation faces many or even an indefinite number of unknown risks (or if these risks are highly uncertain in their impacts and probabilities).

A recent study of seven shocks in Finland (IIASA, 2012) provided three conditions for achieving resilience: adaption to changing environments; agility in using new opportunities; and active renewal. The underlying idea is to rely more on “glocalised networks”, i.e. local networks that operate globally. If one element of this network is disrupted or destroyed, the network as a whole can renew itself quickly.

A similar notion has been advocated by the IRGC: resilience includes first to guarantee the functional continuity of the system and the services provided; secondly, to limit the magnitude of losses and impacts; and thirdly, to ensure fast recovery.

The following sections will summarise the analysis derived from the six case studies and informed by the nine points. The analysis includes and integrates the presentations and discussions of the two-day workshop in Lausanne with experts and governments representatives. The report is written from the perspective of a public sector decision-maker.

PART II: Guidelines for public authorities on how to deal with emerging threats

Level 1: Basic requirements

At Level 1, the question of “who” is crucial. Who should be reporting about what to whom? Who should be accountable in what ways to whom? And for inclusive governance, it is about who should be involved in the process?

1. Transparency of process and substance

Transparency comprises two different dimensions: the governance process itself (procedural transparency) and information on the emerging risk and its handling (substantive transparency). If information about the risk and its implications cannot be fully disclosed for confidentiality reasons, it is of utmost importance to guarantee full procedural transparency. This covers openness on the decision-making process, the checks and balances put in place to ascertain a fair treatment of all arguments and full disclosure about the procedures to assign trade-offs.

Of course, it is preferable that information about the risk and its implications is openly communicated to the public. This includes comprehensive and understandable information to the world inside and outside of the risk topics under review.

Transparency needs to be sustained over the entire governance process. If new information or new insights arise it is important to make them public. Transparency is inevitably linked to communication, which will be discussed in the section on communication.

For structuring information on both procedural and substantive transparency the two dimensions of inclusion and closure are essential. Inclusion describes who will participate in the governance process (which stakeholders, which agencies etc.) and what issues and at what scale will be addressed (e.g. new data on emerging risks on a local/global scale). Closure refers to the mechanisms of how decisions are being made and what procedures are selected for making trade-offs and for deciding what options to choose.



A lack of transparency can trigger and fuel conflicts. These conflicts can be caused by different interests, values and knowledge claims. They may be reinforced by social dynamics and power asymmetries. Transparency is a necessary condition to identifying conflicts and to making people aware of them, but it is not sufficient to handle or even resolve them. A constructive handling of conflicts requires active stakeholder involvement, public consultation and, in some cases, also mediation and negotiated rule-making. This will be discussed later.

What do the case studies tell us about transparency?

All case studies have very different approaches to the issue of transparency (in the same manner as accountability – see point 2). The **interaction case** illustrates that transparency largely depends on the specific political context. In situations of social unrest transparency will not be of the utmost importance for most political institutions. However, transparency can endanger existing power structures if not properly managed. Exchange of information across agencies is crucial. In contrast, the **supply chains case** illustrates the intrinsic need for transparency, which is reflected in the supply chains process itself: all actors involved have information on supply chain structures and processes regarding food safety and quality issues. Here, transparency towards the downstream supply chain customers and the end consumers is crucial for the success of any risk management effort. The **infrastructure case** demonstrates that, in the case of path-dependency and lack of accountability, transparency decreases, which again exemplifies the interconnectedness of elements within the risk governance chain.

Box 1. Transparency versus security – the H5N1 case

“The journal *Science* embraced the controversy by including extensive commentary on pros and cons of the H5N1 research and publication in the June 23, 2012 issue in which revised Fouchier piece was ultimately published and by granting open access without fees to that issue. External technical assessments of the NSABB [National Science Advisory Board for Biodiversity] risk assessments mirror the disagreements within the board. However, there is near unanimity in external recommendations on process, with critics and supporters of the NSABB decision concurring on the need to engage civil society in dialogue early on. For example, Fauci and Collins note that the intensity of disagreements within the scientific community on risks and benefits of the H5N1 research underscores the need for a rational and transparent explanation of how decisions on research funding and publication are made. They call for a social contract among the scientific community, policy-makers and the general public that builds trust, albeit without specifying how such a social contract might be developed. There is also near unanimity among critics and supporters of the publication decision on the need to fill gaps in technical knowledge on influenza risks on fundamental issues such as the extrapolation of data on virus transmission and pathogenesis from the ferret model to humans, and the need to improve turnaround times between virus isolation and sequencing to provide for real time surveillance. However, there is intense disagreement within the scientific community over the practical value of the Fouchier H5N1 gain-of-function research” (**Synthetic biology case**, p. 18)

The **synthetic biology case** illustrates how tensions related to transparency can be important. On the one side, high-security information is sensitive and often kept confidential. When crucial information is not kept confidential, release of pathogens in the environment can occur. On the other side, the current governance of synthetic biology development is based on scientific principles highlighting the need to provide a transparent explanation of methods and results. Depending on specific cases, commercial firms involved in the sale of DNA parts can either encourage confidentiality or openness, but are usually protective of their interests. The tension in this respect can only be solved on a case-by-case basis, because of the high sensitivity of certain information. One can conclude from the **synthetic biology case** that transparency is context sensitive (there are often good reasons to keep information confidential). It must be made transparent, however, what is kept confidential and what is not.

The **AMR case** shows yet another approach. Here again, the entire risk management process established by the Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (DANMAP) takes advantage of an inclusive and integrated approach. Transparency is set as an objective of the whole process, facilitated by the involvement of all relevant actors. Transparency in the management process of AMR also provides more credibility to the decisions, making them more easily accepted by all involved actors. The information itself must meet two criteria: readability and accessibility.

Box 2. Transparency in DANMAP

“Through the integrated approach in DANMAP a broad audience was reached including all relevant private and public stakeholders. With the reports publicly available on the internet everyone had access to the information. This made the situation around the use of veterinarian antibiotics and the risk for human AMR more transparent, helping to cover the gap in knowledge. This made implementation of risk management interventions easier and more broadly accepted.” (**AMR case**, p. 19)

Transparency also makes it possible to assign accountability. Furthermore, as described in Box 2, a broad audience can be reached, which enhances the legitimacy of the whole process.

The hallmarks and drivers of transparency can be summarised as follows:

1. The hallmarks and drivers of transparency

- a) The credibility of risk management depends on transparency. One distinguishes between procedural and substantive transparency. Procedural transparency covers the process of decision-making, substantive transparency the content of the decision-making process. As the H5N1 case illustrated openness about procedures and process can substitute for lack of substantive transparency even if for many reasons full substantive transparency is not possible.
- b) Transparency is necessary for effective communication but not a replacement for communication. If risk management appears as secretive even the best communication programme will most likely fail. Transparency by itself is, however, insufficient to convey the rationale, the procedures and the necessary trade-offs involved in public decisions.
- c) Accountability and transparency are closely coupled (see point 2). Accountability is necessary to achieve transparency. Substantive disclosure about the risk and its circumstances may be less important than clarity about who is responsible, and what the agreed-upon procedure in crisis situations is (**AMR case** for transparency; **synthetic biology case** for transparency in conflict with confidential information).
- d) If different actors and stakeholders are involved in the process, transparency needs to be extended to all partners and an agreement needs to be reached that the degree of transparency is similar among all the parties involved (**AMR case**). Otherwise a division in terms of “good” and “bad” guys (potential scapegoats) is likely to occur.
- e) Transparency includes both availability and comprehensibility for the target groups, e.g. published material (**AMR case**).
- f) Not all situations require transparency. Security-related information, for example, often needs to stay confidential. However, in most cases transparency can be established about the reasons why some information is disclosed and how checks and balances are secured (**synthetic biology case**).

2. Accountability for process and outcome

Accountability requires transparency about the people or organisation in charge of a task. There is a tension between the diffusion of responsibility within an organisation on the one side and direct liability to negative outcomes on the other side. The notion of direct liability impedes the willingness to accept accountability, thus incentives are needed to foster a readiness to accept accountability. Embedding accountability into a system of checks and balances makes the assignment of accountability easier within an organisation.

Accountability is closely connected to the values of an organisation. Refusal of actors to assume accountability often stems from inconsistent value patterns within an organisation or unclear responsibilities between organisations. Assigning someone to be an explicit risk owner can solve this problem, as well as being an aid to developing a well-internalised risk culture. Accountability is always linked to clear command and report structures (they do not have to be hierarchical but unambiguous) and sufficient capacity building to provide enough agency for those who are accountable so that they have the means to be influential in managing the risk. Often people are required to take responsibility for actions that they are unable to control. This creates frustration and destroys loyalty to the organisation (scapegoating).

Accountability may change over time. This might be due to the following contributing factors to risk emergence (as described in the IRGC report on the same topic¹):

- Scientific unknowns;
- Loss of safety margins;
- Varying susceptibility to risk;
- Technological advances; and
- Temporal complications.

All these contributing factors describe situations in which accountability may shift from one person to another, from one department to another and from one agency to another. Thus, decision-makers and risk managers need to ask:

- Who is legally liable with respect to the emerging risk? How is liability related to organisational accountability?
- Under the specific situation, is it possible to assign accountability to more than one actor without diffusing responsibility and control?
- What are effective incentives for individuals in an organisation to take on accountability?
- How can accountability be adjusted to changing environments and context conditions?

Accountability should be ascertained at all stages of the risk governance process, i.e. risk identification, assessment, evaluation, management and communication. However, analysis of the case studies showed that accountability is often lacking in the entire risk governance cycle. Often different actors or institutions do not feel accountable at all stages. Often they are not aware of their responsibility in the chain of accountability.

The **synthetic biology case**, displaying a hybrid governance system of public and private actors, illustrates how problematic the issue of accountability can be. Although the governance system seems to be satisfactory according to many constituencies (at least in the short term), it seems difficult to assign governance responsibility at the level of hazard accountability (the source of the risk). The inability to assign accountability and the lack of will to hold accountability in this case eventually lies within the own limits of the governance system, which is based upon a voluntary agreement. No single institution regulates or coordinates efforts in the governance process, which is also due to the cross-national border nature of the issue itself.

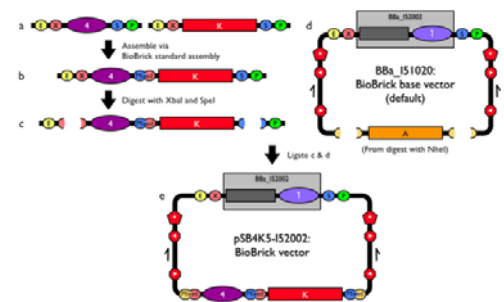


Figure 2. How to construct a BioBrick (source: Registry of Standard Biological Parts)

Box 3. “The need for a Republic of Korea response to emerging social risks”

“The Government of the Republic of Korea reacted to the economic crisis in 1997–98 with a set of social policies. It expanded the coverage and benefits under the existing public social insurance scheme significantly (protection against unemployment, health insurance and pensions). It also implemented a fundamental reform of the public assistance programme to secure a minimum standard of living, independent from age or work ability.

Nevertheless, the Republic of Korea is still facing enormous future challenges. The country is at the beginning of a severe demographic transition from one of the youngest societies today to the second oldest among OECD countries by 2050. With the economic growth of the last decades, inequality has also risen dramatically. It has a highly segmented labour market between regular and non-regular workers, a malfunctioning tax system in terms of income redistribution and, despite the reforms mentioned above, the social spending rate is among the lowest in the OECD countries.

This is because the introduction of social security measures happened in the context of liberal reforms of the Republic of Korea economy that aim to open markets for foreign investment and minimise interference by the state. The social system therefore creates strong incentives to remain a part of the

¹ See http://irgc.org/IMG/pdf/irgc_ER_final_07jan_web.pdf

labour force and promotes self-support. As a result, some parts of the population, namely the poor, remain with very limited access to social protection.

While the political situation in the Republic of Korea is currently stable, the government needs to introduce policies that will mitigate the economic and social risks that could otherwise emerge. To address the risk of an economic decline, labour productivity, especially in the service sector, needs to improve drastically to close the income gap. It is further important to reduce the share of non-regular workers who are less trained and protected. Regarding the demographic situation, the Republic of Korea has to promote the role of women and older people in the labour force.” (**Interaction case**, p. 17)

The **infrastructure case** illustrates a similar situation: the difficulty to identify effective responsibility for maintaining public infrastructure. This may eventually lead to a lack of accountability in case of transfer mechanisms to other actor(s). In both cases, when political accountability and legal liability are not clearly distinct from each other, it is more difficult for actors or institutions to accept accountability. For example, legal liability for damaged infrastructure includes the duty to compensate financially for damaged infrastructure, and often such issues are part of a lengthy process that frequently takes place in courts [what point is being made here – that legal action is resorted to rather than the issue being handled in a more ‘automatic’ compensation system?]. If in the perception political accountability is tied to legal liability, it will be just as hard to assign or accept political accountability.

In the **interaction case** the question of accountability depends on the specific national and cultural context. Examples provided in the case study suggest that in situations of social unrest accountability is difficult to assign to one specific actor, and some might try to delegate accountability to another party. Governments are expected to be accountable for providing security to their citizens (see Box 3). However, as this case illustrates, it can also be based on self-support where there is a lack of social security.

A different approach is illustrated by the **AMR case**. The issue of accountability is solved here via the approach that “the risk has parents”: DANMAP (the monitoring and research programme) explicitly deals with the risk by creating a transparent process with all relevant actors involved. Transparency and accountability go hand-in-hand, and in the DANMAP case, outside observers of the process can always see who is tasked with what at each stage of the process, which is further facilitated by the separation of risk management and risk assessment.

Box 4. The role of organisational cultures

“However, most of the infrastructure failures described in this paper can be traced to a large degree to organisational cultures that placed other objectives above the core values (i.e., safety or reliability) of the organisation and which failed to comprehend fully the potential consequences of these actions.” (**Infrastructure case**, p. 28)

Accountability can also be discussed in the context of the distribution of risks and benefits. The **infrastructure case** illustrates that accountability tends to be low when the benefits of infrastructure investments are gained at the local level, while the burden of investing tax money is shared at a national level. Taking this a step further, if risks and benefits are brought to the same level (i.e. institutions, actors, etc.), i.e. regionalised, the overall accountability of the process will be increased.

We can conclude from the case studies that accountability is most effective if there are clear structures (as in the AMR case, where it is clear from the “outside” who is responsible for which task at what time). Each of the actors in DANMAP was given specific responsibilities. In contrast, the case on synthetic biology has shown that even in a well-functioning governance structure, ascertaining accountability is not obvious. The infrastructure case shows clearly how accountability can become a vicious cycle of passing the buck of responsibilities and accountabilities from one actor to another.

2. The hallmarks and drivers of accountability

- a) Separate legal liability and political accountability. Make sure that political accountability includes public expectations about moral accountability (**infrastructure case** for a conflict of liability and accountability).
- b) Diffusion of accountability is an invitation to disaster. However, making someone accountable places a major burden on them. There needs to be some benefit or at least a plausible justification associated with this assignment of responsibility (**infrastructure case**).
- c) Accountability is an expression of personal or institutional agency. It demonstrates that an institution feels responsible and acts accordingly. This is a necessary ingredient for building trust.
- d) Shared accountability (as in the case of Denmark; **AMR case**) is easier to implement since accountability is not assigned to one institution alone and decreases the burden of accountability. However, one should be aware that implicit risk transfers are made explicit and are justified as part of the responsibility sharing.

3. Inclusive governance approach

Inclusion is the last basic requirement at the first level. The main objective is to involve actors from the private sector, the public sector and civil society in joint dialogue and engagement in the risk management process. There is not a single model of how to include actors in the process. Which actors should be invited and what procedures of involvement should be selected depends on the specific situation. A distinction can be made regarding the type of underlying conflict: if the process of risk assessment is likely to bring up knowledge conflicts (i.e. conflicts of a scientific nature) external experts should be included in the process. If it is likely that a conflict about distribution of risks and benefits is encountered (i.e. which option to choose under uncertainty) affected stakeholders should be included in the process. If a normative conflict occurs (i.e. a conflict on values or worldviews) representatives from civil society should be included in the process. The decision on the rules of involvement lies at the core of the risk participation ladder underlying the IRGC risk governance model. Furthermore, in the case of emerging threats it is essential to define potential intervention points on the basis of scenarios where external experts and stakeholders need to be consulted.



Besides the question of who to include it is also important to ask how the inclusion should be organised. The empirical case studies showed a variety of possibilities about how actors can be included in the risk governance process. None of these options are better or worse than the others, rather they have to be adjusted and fitted to the situation and the problem at hand. As with transparency, involvement processes can be structured into two dimensions: inclusion (who is taking part in the process? What counts as evidence?) and closure (how are decisions being made? Who has a mandate for what?).

The main contributing factors to risk emergence addressed by the inclusive governance are:

- Communication;
- Information asymmetries;
- Social dynamics; and
- Scientific unknowns.

Decision-makers and risk managers should ask the following questions when thinking about inclusive governance:

- What do we know about the risk and what type of conflict can we expect (about knowledge with respect to probabilities and impact, fair distribution of risks and benefits or principles and values about the activity in general)?
- Who should be included in the process (stakeholders, other agencies, representatives of the affected populations)?
- What boundaries are there for the inclusion in terms of time, structure and actors?
- What is the mandate of the involvement process?

The degree of inclusion is different between the case studies, as is the structuring of the inclusion process for different actors. Here are four possible cases:

- Actors are loosely connected (see **interaction case**, **migration case**);
- Actors participate in well-organised processes (see **supply chains case**);
- Various actors involved work together within a structure but not all actors are involved (see **infrastructure case**, **synthetic biology case**); and
- Actors contribute to the creation of a platform for engagement that shapes a new institutional setting (see **AMR case**).

The cases also illustrate variations regarding the time horizon of inclusion. The **infrastructure case** shows a high degree of inclusion in times of crisis (e.g. as in the case of the response to Hurricane Katrina), whereas the **AMR case** shows a constant inclusion over the risk management cycle.

Box 5. Inclusion in the AMR case

“The farmers, literally had to pay the price for using antibiotics and the consequences of the ban, but they could also benefit from the ban through possible savings. It is, therefore, important to involve the farmers in the whole process of monitoring and decision-making and inform them on the benefits and risk of using antibiotics.” (**AMR case**, p. 25)

“DANMAP integrated a national cross-sector surveillance programme to assess the risk of AMR. The collaboration between microbiologists, physicians, veterinarians and epidemiologists offers a broad range of expertise and professionals.” (**AMR case**, p. 19)

The authors of the **AMR case** point out the crucial role of incentives for stakeholders to become involved. The incentive for farmers to implement the ban on antibiotics in animal feeding was two-fold: first there were possibilities to benefit from not using antibiotics, second being part of the decision-making process created the possibility to have ownership over the process and its outcomes.

The **AMR case** demonstrates successful inclusion of various stakeholders in the process that led to banning antibiotics from animal feeding and avoiding antimicrobial resistance in humans. When the process started in 1995 all involved stakeholders identified benefits in participating in the assessment and management process. They did make some losses following the ban on antibiotics; however, the losses were smaller than the benefits, or of a different kind, or compensated through their participation in the decision-making process. The authors stress the role of trustful collaboration as a prerequisite for this form of inclusion.

The **synthetic biology case** shows a more flexible inclusion, albeit with fewer stakeholders: private actors (commercial companies), public institutions (regulators) and the scientific community. However, the need for societal inclusion is clearly demonstrated, as many of the problems are of normative nature and have to be discussed with civil society.

Both the **AMR case** and the **synthetic biology case** illustrate that stakeholders need to be convinced that their participation will benefit themselves. Benefits can be of very different kinds, but it has to be clear for all actors what they can expect from their participation. Emphasising the need for developing trust between and among actors (as a way to foster inclusion) points out the need of establishing processes for sustaining interaction and integration (see Part I).

In contrast, fragmented accountability, as illustrated by the **infrastructure case**, makes inclusive processes difficult to accomplish. In this situation trust is hard to create or maintain as actors fear that they would have to bear more of the burdens compared with the expected benefits from their cooperation.

3. The hallmarks and drivers of inclusion

a) Positive incentives facilitate the involvement of actors. Incentives can be of different kinds and can include an avoidance of monetary losses, the expectation of direct benefits or reduced risks, the possibility to take part in the decision-making process instead having regulation imposed, improvement of public prestige and enhancement of trustworthiness due to being part of the process (**synthetic biology case**, **supply chains case** and **AMR case** discussion on the role of incentives). Enhancing the motivation for potential partners to enter into cooperation is crucial for a successful inclusion. Such motivation could also include a trade between sharing information and experiences against more free space for self-regulation.

b) The degree of inclusion (number of actors, topics, duration and scope) has to be adjusted to the specific process, and there is no general rule regarding who to include and what needs to be deliberated. However, it is essential to have a rationale for the two crucial issues of “inclusion” (who and what) and “closure” (how is the process governed and what happens to the process outcomes) (discussion in the **synthetic biology case** on the question of who to involve and the **AMR case** for the structured approach to resolving this question).

c) It is crucial to clarify the mandate of the process and to define what happens with the outcome; if actors cannot foresee what effects their commitment might have they will not sign up to the process (**AMR case** for providing that clarity).

Level 2: Organisation of governance: structures and procedures

Successful risk governance of emerging risks needs to answer questions on how the governance is supposed to unfold over time. There are two major tasks to meet: integration (among impacts, departments, public and private entities) and evaluation.

4. How should integration be achieved?

Integration promises opportunities for an optimisation of the risk governance process, as opposed to a fragmentation of strategies and responsibilities. Thus, integration among the entire scope of potential impacts, integration among departments and integration between public and private entities are important facets for a comprehensive and effective risk management process. However, cooperative strategies, might lead to inertia if all effort is focused on reaching a consensus or a mutual agreement rather than on dealing with the problem at hand. Optimisation thus includes both a clear strategy for integration but also a clear command structure that assigns accountability and responsibility to each actor involved in the process (see point 2 of the report). Integration certainly requires resources in terms of money, time and commitment. Yet the increase in efficiency and in pursuing a unified strategy can compensate the expenses of a cooperative solution. Integration also fosters realistic expectations on the nature of emerging risks. Often single organisations have the tendency either to underestimate or to overestimate pending threats. Seeking the cooperation of other organisations helps to develop a more realistic perspective.



Integration addresses contributing factors to risk emergence:

- Communication;
- Information asymmetries; and
- Conflicts about interests, values and science.

Integration is one of the issues widely discussed in relation to risk governance. It includes various components. It is often a challenge since it requires innovations in organisational procedures and routines.

Integration is necessary at several levels. The first level consists of the various impacts such as physical, social, economic or environmental consequences. So-called “systemic risks” are characterised by cross-cutting impacts and multiple feedback loops that endanger the functionality of entire sections of society. If one focuses on one specific impact, other unexpected or unanticipated impacts may be neglected, and then occur as a surprise. Secondly, risk management requires integration within an organisation (among units) and between departments or public agencies. In most cases, departments have specific mandates that include responsibility for only subsections of impacts such as health, environment or financial stability. In addition, many departments or organisations have developed a “silo mentality”. To ensure integrated management of the different impacts it is therefore necessary to ensure integration among and between departments or agencies. Thirdly, integration between private and public entities can lead to improved risk management if an effective handling of the risks requires a coordination of public and private measures (for example public building codes and private real estate investment plans). Integration between public and private sectors can be useful to explore innovative strategies of cooperation, as experiences, constraints and opportunities often differ between the two sectors. Furthermore, close collaboration is advisable for the evaluation and selection of management options with uncertain implications.

This leads to specific questions that decision-makers must ask when thinking about integration:

- Is there sufficient trust between the relevant actors who are involved in the process? How can it be fostered?
- What incentives can be offered to different actors to become involved?
- Is there enough clarity and transparency about the rules of integration?

- Are there any legal or organisational constraints for more cooperation and how can they be overcome?

Box 6. “The Guardian case” (mail order synthesised smallpox DNA)

“In 2006, the [British newspaper] *The Guardian* showed that fragments of pathogenic DNA could be ordered from commercial DNA synthesis houses without detection or safeguards. Reporters ordered an incomplete fragment of the smallpox sequence for delivery to a residential address. They found that four firms in the UK and 39 firms in North America synthesised DNA and that none screened orders. In June 2006, *The Guardian* published the results of their investigation in an article entitled “Revealed: the lax laws that could allow assembly of deadly virus DNA”. Smallpox has been eradicated in nature and exists only in guarded installations. *The Guardian* team reported that systems of physical material control could potentially be circumvented by the combination of information on a pathogenic sequence and the use of synthesis methods to produce incomplete sequences. The earlier Spanish influenza re-creation had shown that the assembly of incomplete sequences into a functioning whole organism was possible.” (**Synthetic biology case**, p. 8)

Pointing out the necessity for integration, however, is only half the task. The other half consists of exploring the best routes about how to achieve such cooperation and how to identify drivers and hallmarks that are likely to foster or hinder integration. Empirical material from the case studies sheds light on integration via practical examples.

Integration, as pointed out above, usually relates to more than one dimension. The **interaction case** reflects on the high interdependency of issues and the interaction of emerging economic and social risks. It demonstrates the necessity of developing early-warning frameworks that would integrate communication and exchange between ministries and agencies.

The **synthetic biology case** demonstrates an intriguing example of a hybrid governance system in a highly complex field (“risks are now being governed by a mixture of public policies and private consortia”, p. 6). The risks described in the **synthetic biology case** relate to biosecurity and to the release of pathogens in the environment, both facilitated by the simplification of DNA synthesis. For example, it is now feasible to “recreate” virulent viruses such as smallpox or Spanish influenza by assembling materials from different sources. Prominent examples include the “*The Guardian case*” (see Box 6 above). In response to this case and the post-911 anthrax incidents, the United States Department of Health and Human Services in consultation with the FBI, private firms and international organisations, issued the *Screening Framework Guidance for Providers of Synthetic Double-Stranded DNA*. Associations of private DNA synthesis companies participated in formulating the voluntary framework guidance and developing software, data bases and operating procedures for use by their member companies to comply with the framework. Member firms compare sequences ordered with data bases on sequences of concern and compare purchasers of DNA sequences of concern with data bases of trusted, suspect and unknown customers. At present, the International Gene Synthesis Consortium (IGSC) and the International Association of Synthetic Biology (IASB) are active in developing and maintaining screening protocols for DNA synthesis firms.

The **AMR case** provides an example of a sophisticated balance in the integration of different public and private actors for combatting food-borne microbial resistance.

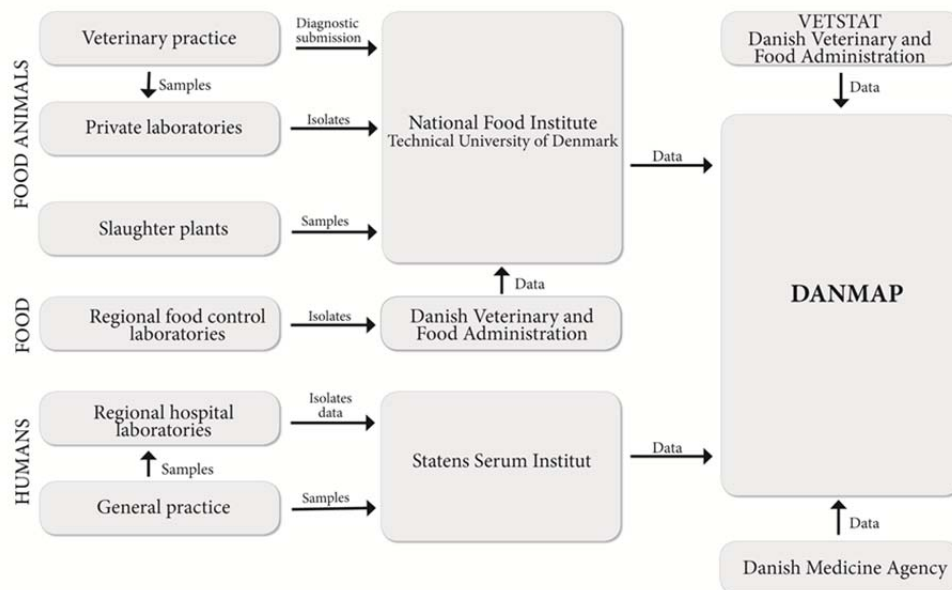


Figure 3. DANMAP process, established in Denmark for combatting antimicrobial resistance (AMR)

The Danish Ministry of Food and Agriculture together with the Ministry of Health have initiated an integrated and multi-stakeholder approach via DANMAP. DANMAP both “integrated and separated [the] different factors in the process of risk management. [...] it made evidence-based decision-making possible which helped to bring together and convince all relevant stakeholders and ministries”. (**AMR case**, p. 18)

Since 1995, when scientific results led to a discussion on how to manage the risk of antimicrobial resistance due to antibiotics in animal feed (as growth promoters), all actors involved in this issue came together with the task of sharing and integrating different views, values and interests in the risk management process without marginalising the crucial role of official authorities. Integration in this case relates directly to governance, including monitoring.

Drivers for integration, in both the **synthetic biology case** and the **AMR case**, are primarily the protection of private interests. In the **synthetic biology case** private companies were concerned about liability trials if parts of the DNA sold to their customers were used for malicious acts. In the **AMR case** farmers in Denmark feared that they would not be consulted in the process of banning antibiotics in animal feed. Thus, self-interest is a driving force for participating in any integration efforts.

A second important feature of successful integration efforts is timing. Cooperation needs to be organised as an on-going activity as opposed to a short-term exercise. On-going activities are demanding for constituencies; but they are more likely than short-term exercises to lead to more robust and sustainable outcomes. If there is added value for the involved actors, an on-going activity produces synergistic effects that provide sustained efficiency of management efforts. The structures and processes developed in the two cases mentioned above are designed to operate as permanent bodies. This includes the capacity for flexible structural change.

The request for on-going activities does not conflict with a strategy of oscillation between dormant and highly active phases in such cooperative arrangements; for example (**synthetic biology case**), social networks of actors involved in the anticipatory evaluation of potential biosecurity risks from synthetic biology meet only when there is need for immediate action. One case was the “Heidelberg meeting” in

March 2012, aimed at identifying new emerging risks and contemplating suitable responses. Thus, a working combination of institutional permanency and event-driven flexibility is crucial for assuring an optimal level of integration.

Integration is dependent on the will of all involved actors to participate. Internal communication is necessary, as integration is more difficult to achieve if the actors within the institutions are not convinced that the cooperation will yield any benefits to them. An example of this difficulty is given by the **infrastructure case**, when infrastructure managers failed to seek collaboration with others, relying on their own knowledge.

The analysis of the case studies proposes some specific hallmarks and drivers with regards to integration.

4. The hallmarks and drivers of integration

a) Trust between relevant actors is crucial for successful integration, and trust has to be sustained through on-going interaction between all relevant actors of a risk field. The **synthetic biology case** and the **AMR case** both demonstrate that strong efforts invested in mutual collaboration and communication result in a high level of trust.

b) Incentives are needed for actors to engage in closer collaboration. Incentives include not only economic benefits but also symbolic or political aspects such as being invited to take part in the decision-making process rather than being regulated (**AMR case**) or building an alliance with potential competitors (**synthetic biology case**). In order to foster cooperation among public agencies offering shared expertise and shared responsibility through an integrated common body can be a powerful incentive.

c) Optimal integration enables optimisation of resource allocation and capabilities. It pools relevant knowledge, expertise, experience and resources. This effect can be reached only if all the involved parties have realistic expectations about the contributions of the other parties and are highly motivated to cooperate rather than to compete.

d) Integration requires transparency about the rules and the practices that govern the integration (**DANMAP in the AMR case**). Otherwise the cooperation looks like a closed shop to outsiders. In order to avoid frustration, actors constantly need to know what their roles and responsibilities are while collaborating. This also avoids diffusion of responsibility and accountability.

5. Best available approaches to evaluation and monitoring

A crucial part of any successful risk governance process is the constant monitoring of the methods and procedures on how to assess, manage, communicate and evaluate the risk. If the methods and procedures of the governance process are not properly monitored and reviewed, the whole process may fail. Thus, the actors involved as well as observers have to understand what measures are planned and implemented and what purpose these interventions are supposed to have. Evaluation always includes a comparison between what is and what should be.

Monitoring procedures and methods affect all contributing factors to risk emergence. Whether one looks at social dynamics, technological advances or malicious acts and motives: monitoring the effectiveness of all management interventions is crucial to understand the causal relationships between action and response and to optimise the risk management efforts based on evidence rather than belief. In most cases monitoring and evaluation is not trivial as complex threats require transdisciplinary methods, for which standards of best performance are often not available or are contested among experts. However, even when evaluation methods are not easily available, the need for monitoring the adequacy and effectiveness of management strategies, methods and policies is paramount to organisational learning and promoting an adaptive management style.

In this respect risk managers need to ask questions such as:

- What scientific expertise is necessary to monitor and evaluate the adequacy and effectiveness of management methods and strategies?
- What procedures are implemented to assure constant and successful evaluation and monitoring of intervention outcomes?

As illustrated in the **AMR case** and the **synthetic biology cases**, risk managers need to convince their respective audiences that both the scientific/technical data (that are used for evidence-based decisions) and their collection (procedures) are relevant and appropriate for the decisions to be made. In the **AMR case**, DANMAP was the basic tool for the management of antimicrobial resistance caused by the use of antibiotics in animal feed. This tool was constantly tested and re-tested for demonstrating its effectiveness. Within DANMAP, an evidence-based risk assessment was undertaken in collaboration with different disciplines. This created a level of transparency that enabled stakeholders to check and evaluate the analysis. Thus, no scientific “black box” existed, which underscored the importance of inclusion of such different stakeholders as farmers, industry and scientists.

The situation is slightly different in the **synthetic biology case**. This case identifies and evaluates possible biosecurity risks incurred by the release of dangerous pathogens in the environment. Evaluation and monitoring was not formally structured, but organised on an ad hoc basis, as informal consortia of experts commented on the measures that were taken. A more organised process of evaluation by all actors, including civil society, would allow more legitimacy.

The **supply chains case** illustrates an unstructured, informal and complex network of actors, methods and procedures (mainly in the hands of the private sector) as far as quantitative risks are concerned. However, formal and elaborate methods and procedures for evaluation and monitoring have been applied for interventions involving qualitative issues, such as food safety. In the case of food-related risks, the ultimate confidence in the risk management process is provided by the satisfaction of the end consumer.

The **infrastructure case** provides elements to evaluate whether management efforts address the risk of ageing infrastructure adequately. The case illustrates that the methods and procedures to deal with the problem are quite often inadequate. Two types of concerns exist: firstly, the methods used for funding the maintenance of ageing infrastructure and for allocating resources are not delivering what they promise to; secondly, certain governance issues related to how people and organisations face the risk of ageing infrastructure and make decisions about it do not provide the necessary positive incentives. Given these shortcomings, the case also illustrates that some organisations have been able to demonstrate that designing responses in accordance with the revealed concerns adds legitimacy and credibility to the assessment process.

Two factors are mainly responsible for a positive evaluation of methods and procedures for emerging risk governance. Firstly, the procedures and methods for scientific/technical risk assessment have to be accepted by all stakeholders involved, as well as by outside reviewers. Secondly, the methods and procedures for how decisions are made, how trade-offs are resolved and how conflicts are solved, must be approved or at least respected by all actors involved. While the former (assessment techniques and methods) evolve relatively slowly, the latter evaluation tools evolve constantly. Those need to be carefully monitored and feedback processes are necessary to make the process more adaptive if context conditions change.

5. The hallmarks and drivers of convincing methods and procedures for monitoring and evaluation

- a) Learning requires organised efforts for monitoring and evaluation: all interventions to address the emerging threat should be the subject of a systematic monitoring and evaluation effort.
- b) Most risk management policies transcend the boundaries of one discipline. It is important to use combined methods that are state-of-the-art within each discipline or engage in transdisciplinary methods that are innovative but still effective in terms of validity and reliability. This can be assured by establishing an effective and reliable monitoring system.
- c) It is important to separate the factual assessment (monitoring of results) from the evaluation of the interventions and policy options. The assessment should be independent of potential conclusions about success or failure since wishful thinking might colour the assessment process. Based on a thorough analysis of intervention impacts risk managers should consider what lessons they need to draw from the evidence presented to them. It may be helpful to include stakeholders in this evaluation process.

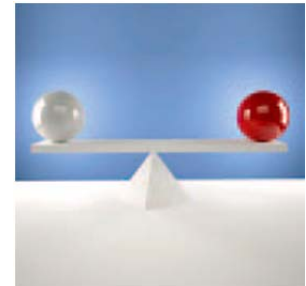
Level 3: Risk prioritisation and adequate time management

The third level includes two consecutive steps, prioritising risks and determining the right timing. What is the most important risk to deal with and what is the right timing for initiating the necessary steps?

As pointed out before, the presentation of the nine points in consecutive order in this presentation does not necessarily imply a preferred sequence. Prioritising risks and determining the right timing can also mark the beginning of the risk governance process.

6. Risk prioritisation

Prioritising risks is a crucial task in risk governance. Focusing on minor risks (that are acceptable without the need for management measures) can lead to negative consequences, for example on budget and reputation. At the same time, however, ignoring or neglecting “important” emerging risks (that require management measures) can have dreadful consequences. However, in many cases, it is difficult to anticipate how an emerging risk will develop and what kind of consequences it might produce over time. In some cases, it may be possible to anticipate the severity and probability of the occurrence of an emerging threat, but most of the time either one of the risk components or even both components are laden with uncertainty and ambiguity.



Prioritising risks is further complicated if the issue is embedded in social or political controversy. For example, if a rather unlikely accident occurs, public opinion presses for more control of exactly this type of accident and forces decision-makers to allocate funds to preventing such events in the future at the expense of leaving more probable risks unattended. Especially if a disaster strikes, policymakers are confronted with strong public pressure to prioritise the risk from which the disaster originated (natural or technological). At the same time, hazards that are difficult to imagine may get underrated in the public perception and it is difficult to justify management programmes that handle such underestimated risks. Public officials as well as private risk managers can address this problem of under- and overestimation of risks by initiating education programmes about risk perception (explaining why people over- and underestimate risks), collecting convincing evidence about the relative seriousness of risks and engaging in early stakeholder involvement projects as means to find a broad consensus on what is a priority risk and what can be delayed for later.

Prioritising emerging risks usually requires dealing with many unknowns. In this situation, the context of the risk can provide important insights. The context can be instrumental for constructing narrative scenarios about the potential developments of the risk. Within this setting, defining risk appetite is of major importance, and the questions decision-makers need to address include:

- How much risk is the organisation willing to take and to cope with?
- What are the trade-offs between addressing and ignoring a specific risk?
- How can an organisation deal with gaps between public risk perceptions and expert assessments when it comes to sorting risks according to their seriousness and need for immediate response?
- How can stakeholders be included in the task of prioritising risk?

It is obvious that the task of prioritising touches upon all contributing factors. Priorities reflect social dynamics and conflicts about values and worldviews. They are at the crossroads between factual assessment and tolerability judgments. Often constructing scenarios (best, worst and most probable cases) help to understand the scope of potential impacts and to determine the sensitive intervention points where decisions need to be made and implemented.

The case studies demonstrate that prioritising risks becomes easier if several partners are included in the prioritisation process (as discussed in chapter 1 [point 3?]). In some cases (as shown in the **infrastructure case**) the task of prioritising risks may be dealt with by transferring risk management and responsibility to other actors. This strategy implies, however, trusting relationships between the

partners. The **AMR case** shows an intriguing alternative approach described as “following the money”. This approach searches for situations in which considerable economic profit is envisioned or pursued. In these situations of alleged high profitability, organisational efforts for prudent judgment and control are biased by the expectation of high profits which in turn may create perverse incentives and unexpected new risks (e.g. through excessive use of antibiotics in the **AMR case**; through underinvestment in the **infrastructure case**; through low food quality in the **supply chains case**; through low investments to improve social conditions of workers in the **interaction case**; through criminal use of DNA material in the **synthetic biology case**; and through the recruitment of migrant workers without developing training programmes in the **migration case**).

The **AMR case** and the **synthetic biology case** illustrate that coalition building with partners can be positive and negative depending on circumstances. It may lead to a well-structured process of risk prioritisation (**AMR**) or to a most trivial denominator focusing on the immediacy and the potential severity of emerging threats rather than long-term implications (**synthetic biology**). Both cases prove to be instructive. It should be noted that the positive AMR case combined joint decision-making with a close programme of monitoring outcomes. This combination turns out to be particularly productive when dealing with emerging risks.

Box 7. Food supply chains case

“Yet, (aggregate) risk management in relation to outside shocks, such as drought, flooding, disease outbreaks, does not appear high on the agendas of the organisations. Much attention is given to compensatory measures to be taken after the event, but little evidence is found of precautionary plans of the private sector at the aggregate level. Probably the tension between costs to their members and benefits at the aggregate level prevent the organisations from devoting large resources to such strategies, and rely (or better: call) on the government to do this”. (**Supply chains case**, p. 13)

The **supply chains case** shows how risk prioritisation often focuses on one main objective, such as food quality and safety (public health concerns) or financial considerations (avoiding losses and maximising gains). As a consequence, other important criteria such as consumer trust or market stability may be neglected. Even when prioritisation is done, it may be based on incomplete information and a reduced set of objectives. Blind spots may remain. This might be due to the specific training and affiliation of the people working within an institution, who tend to be focused on specific types of risks for which they are trained or for which they feel responsible. It is therefore essential to broaden the scope of potential impacts and hire, if necessary, consultants to assess implications that are not the core competence of the respective organisation. For the early prioritisation of risks – early warning or screening – it might also prove helpful to specify the task of searching for risks outside the institutional agenda or the organisation’s familiar environment.

The case on interaction of social and economic risks, (the **interaction case** which focuses on Singapore, but also addresses examples in other countries in Asia and the Middle East), demonstrates that there are many possible causes for a social risk to contribute to the scale of an economic risk and vice versa. All ripple effects need to be considered, as many have the capacity to trigger social unrest (see Figure 4).

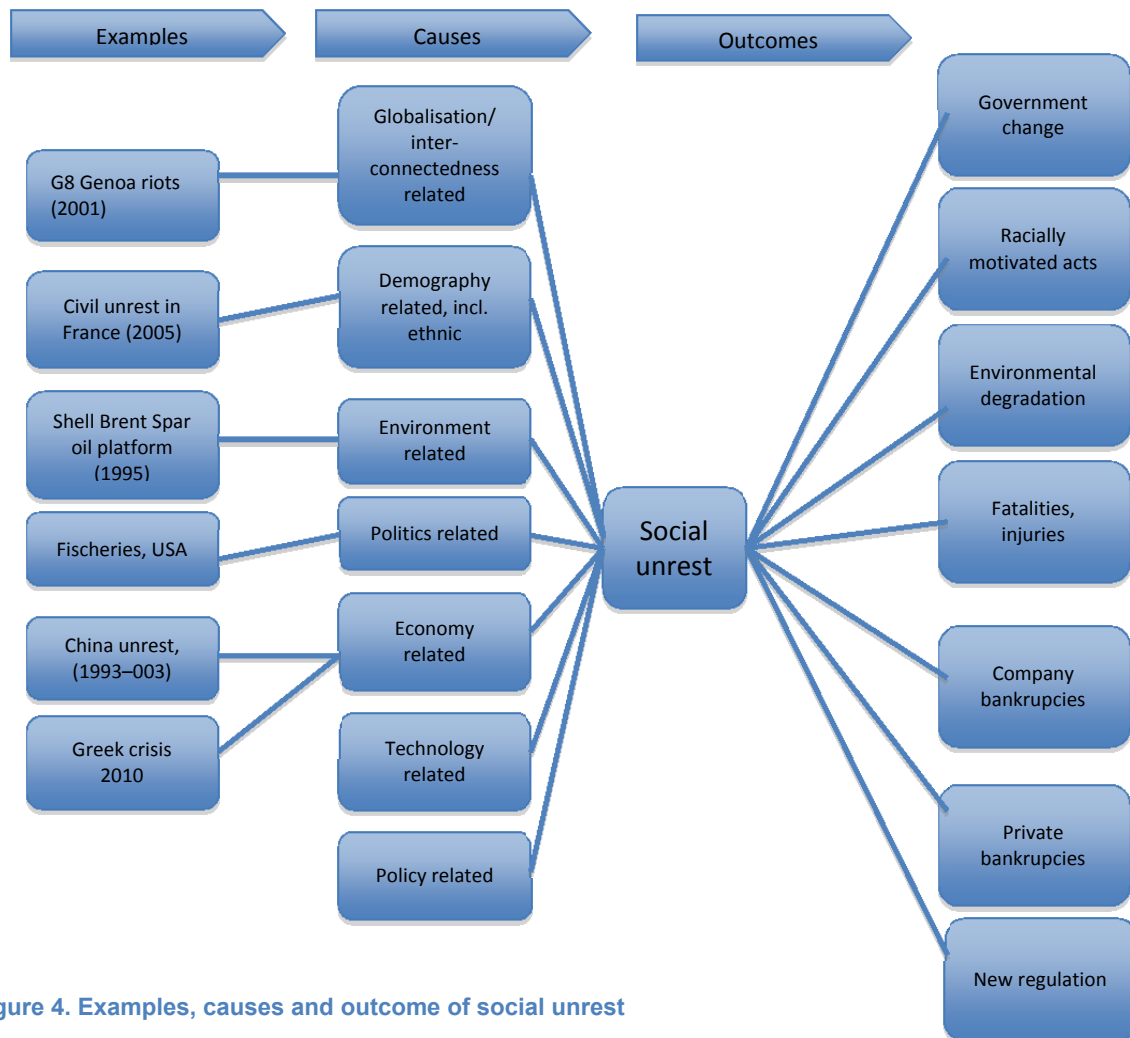


Figure 4. Examples, causes and outcome of social unrest

Figure 4 illustrates two major messages: emerging economic risk may contribute to social risk and vice versa and trigger social unrest. At the same time, social issues alone are not solely responsible for economic problems, nor are economic problems the sole cause of social risk. Thus, one can learn from this case that there is always a multitude of causes and consequences which needs to be addressed when analysing the risk and designing risk management measures. It is of fundamental importance to explore risks outside an institution's domain in order to achieve valid prioritisations.

6. The hallmarks and drivers of prioritising risks

a) In situations where risks proliferate through many actors and institutions it is wise to pursue the “follow-the-money” approach for identifying areas of excessive profit or money transfers, as often risks manifest themselves through perverse incentives. Once these incentives are identified they can be changed or abolished (**AMR case**).

b) Causes and/or consequences of the risk can be outside an institution's knowledge and structure. It is crucial to have a person or agency dedicated for exploring risk causes and consequences outside the institutional knowledge and domain so as not to miss any serious conditions for an emerging risk or one of its major consequences (**interaction case**).

c) It has been proven successful to prioritise risks by analysing the context and “the story” of the risk. This can be best accomplished by constructing scenarios (who is affected and to what degree? How many might be affected? What is the potential damage? When will it be too late to intervene effectively? Who is suffering and who is benefitting from a pending threat?) (**AMR case**).

d) Scenarios are also useful tools to define the most the appropriate intervention points (risk appetite). Risk managers should monitor the context so that they can determine (often with the assistance of stakeholders and partners) when the right point to intervene is reached (**AMR case** and **synthetic biology case** on different ways of monitoring).

7. Time adjustment

Timing concerns the identification and selection of the appropriate intervention points at which decisions need to be made about action and non-action (what to do and how). Risk managers are often afraid of being caught between scaremonger and appeaser. If a necessary risk mitigation decision is taken too late, the risk management process may fail and the risk may not be properly dealt with (for example in the case when a new food safety hazard is not identified early enough). If a risk mitigation decision is taken too early (for example when a ban on a new technology is declared on the basis of incomplete risk assessment), it may incur unnecessary cost or lead to lost opportunities.

Unfortunately, inaction is often “tacitly” not punished, as it is a short-term way to protect an agency or its personnel from the need to deal with an annoying emerging challenge. A vivid example is the *E. coli* crisis in Germany in 2011, where inadequate timing of warnings led to wrong conclusions and had negative effects on the efficacy of the risk management measures.

Questions in regard to the right timing include:

- What is the adequate level of risk appetite in the organisation? How much risk can the organisation handle and control?
- How can an organisation collect sufficient knowledge to know when it is time to act or wait?
- Is stakeholder input required to determine the adequate timing?
- What is communicated about the timing to the outside world?

Box 8. Timing in the AMR case

“A few days after the Danish scientists had discovered the high prevalence VRE among the broiler chickens, the industry was informed about the findings. The Danish farmer organisations agreed to voluntarily stop the use of avoparcin in chicken. While such early decisions by agricultural actors in the face of new scientific findings are certainly not the rule, Danish agriculture has a tradition of using and respecting science. A number of the solutions chosen by Danish farmers, leading to a Danish agricultural system continuously able to compete globally and actually recently becoming the largest

exporter of pork globally, stems from early application of relevant science. It should also be noted that the Danish agricultural system is based on a cooperative system where the farms basically own the full production system, including up to the slaughterhouse and major production industry. All this contributed to a situation where scientific data, if considered valid, would actually also be acted upon by agricultural organisations. The organisations at the time expected government action, no matter what, and therefore wanted to act quickly in order to maintain influence on management decisions. To what degree this played a part is difficult to estimate. Later that same year, the Minister of Food and Agriculture did ban the use of avoparcin as a growth promoter in all animals, so in effect the projection of government action turned out to be true.” (**AMR case**, p. 15)

The **AMR case** can serve as a best practice illustration for identifying relevant time intervals for interventions. A better outcome was achieved by choosing a more inclusive approach for determining time sensitivity rather than by using a top-down approach. Since there was a lack of clear signals for intervention, an integrative approach was the best option to identify the most appropriate intervention points in time, including the judgments of stakeholders and other relevant agencies.

However, the **infrastructure case** demonstrates how harmful inertia can be. In the case of dispersed responsibilities, risk management measures (maintenance of an ageing infrastructure, replacement of vulnerable parts) and crisis response in case of an accident may come too late. A number of recent accidents such as the explosion of the San Bruno pipeline in 2010 in the San Francisco area, the accident on the British Petroleum Deepwater Horizon oil platform in 2011 and also the rupture of levees around New Orleans when Hurricane Katrina hit in 2005 demonstrate the importance of initiating actions before it is too late. Relying on “well-designed” systems is not enough, and it is necessary to develop longer and more costly approaches to achieve safety measures, rather than rewarding efficiency and rapidity.

The **synthetic biology case** also illustrates the crucial importance of timing. With new developments in the field, the dissemination of parts of DNA can enable scientists with little “tacit knowledge” (i.e. little accumulated expertise) to build new organisms that may modify the functioning of other living organisms. In the case of an emerging potentially harmful development it is crucial to intervene early enough to avoid widespread damage. Adequate timing for a scientific peer-reviewed approval process is also helpful so that solutions are worked out before any crisis occurs. For timing to be adequate, effective monitoring capacity needs to be installed (see point 5). Finally, adequate timing is also crucial for seizing the opportunities that the technology may produce. In a fast changing field, a hybrid structure (public-private partnership) may prove to be a flexible and adaptable way of assuring the necessary cooperation for the adequate timing of interventions. Voluntary agreements can be modified as new knowledge develops.

The **supply chains case** describes how supply chain disruptions can occur by surprise (for example in the case of food contamination). In such crisis situations it is essential to take immediate action. But while the release of food hazards requires fast decisions, those must be based on scientifically sound knowledge in order to avoid blind activism (such was the situation with the *E. coli* crisis in Germany). To ensure adequate timing, a close interaction and inclusion of actors is necessary; it enables decision-makers to respond quickly and prudently.

7. The hallmarks and drivers of adequate timing

a) Adequate timing can be achieved by pre-defining mandatory intervention points ahead of time during scenario building and scenario updating. Intervention points describe situations in which actions are probably warranted and still effective (**synthetic biology case**).

b) Adequate timing needs clearly defined structures of communication in order to assure a smooth and effective implementation of measures. An institution should invest in preparedness for timely interventions similar to a structure for preparing responses to a crisis situation (**AMR and supply chains cases**).

c) If the situation is rather complex and uncertain it is advisable to include external stakeholders in the process of identifying the most adequate intervention points and defining the most appropriate response actions (**AMR** and **synthetic biology cases**).

Level 4: Adaptive and flexible management

The main objective of risk governance is to deal adequately with risks and to minimise the implications of potential threats. Inherent to emerging risks, however, is that changing contexts can create new risks originating from well-known sources. Thus, the challenge is to create a rather stable structure that is able to cope with surprises and adapt to a changing environment. The previous seven points are intended to constitute building blocks for the ultimate goal of creating an adaptive and flexible management.

8. How to implement a flexible approach that can adapt to different situations

Risk governance is not a static process. Over time, new knowledge is generated, individual and organisational learning takes place, management strategies are adapted to new circumstances, new intervention points are defined, while monitoring produces new information. Thus, organisations depend on the ability to adapt to new contexts and on the flexibility to deal with new situations.

Box 9. The synthetic biology case

“The combination of HHS Framework Guidance and IGSC and IASB development of protocols for screening customers and sequences has worked well to date. This public-private partnership has permitted greater flexibility and adaptability with reference to sensing changes in the challenges presented, developing appropriate software tools and data bases, and developing methods of handling customers than more formal international arrangements or national regulations would have permitted.” (**Synthetic biology case**, p. 11)

One of the conclusions of the **AMR case** is that flexibility and adaptability require specific mechanisms. Continuous and effective monitoring is a precondition for adaptive management. Learning must be based on evidence about what works and what does not. Learning by trial is increasingly judged unacceptable by society, which expects that negative impacts are anticipated before they affect victims. However, not all impacts can be anticipated so that a dual programme of close observation and evidence-based simulation needs to be implemented. Learning needs to be informed by close monitoring of data and reliable scenarios.

However, we can learn from the **synthetic biology case** that even without a formal monitoring process, (as exercised in the **AMR case**), governance in a public-private hybrid system proves to be highly flexible and adaptive. For example, actors in the complex synthetic biology field, within rapidly changing contexts, have established flexible mechanisms to react adequately to new challenges and adjust their strategies if need arises.

The **infrastructure case** illustrates that, despite the existence of a governance structure, flexibility and adaptability may get lost over path-dependency. Path-dependency leads to inappropriate problem formulation and is contrary to flexibility and adaptability.

Box 10. New Orleans – the trap of path-dependence

Since the 19th century, the United States Army Corps of Engineers (USACE) and its predecessor agencies have been charged with controlling the periodic and damaging floods that occur on the Mississippi River and its tributaries. As a result, New Orleans, subject to both river flooding and tidal storm surge, has seen the almost continuous installation of flood defences during that time. However, a 1977 judicial decision prevented the installation of floodgates on environmental grounds and plans were made to raise the height of the levees. This was not feasible in many locations due to encroaching residential development and the USACE opted instead for building a series of floodwalls on top of the existing levees.

“Nature tested the effectiveness of this flood protection “work on progress” on August 29, 2005, [...]. Multiple levees and floodwall failures as a result of overtopping and poor design, construction and maintenance, allowed water [...] to enter the city and cause widespread flooding.” (**Infrastructure case**, p. 14)

“Hurricane Katrina demonstrated what can happen when the risk management process is manipulated to produce a comforting but inaccurate depiction of likely events.” (**Infrastructure case**, p. 16)

It can be concluded from the case studies that flexibility and adaptability rest on two pillars. Firstly, institutionalised structures creating room for simulation combined with feedback loops and monitoring can ensure flexibility and adaptability. It is also important to have all affected actors included in the adaptation process, such as shown in the **AMR case**. Secondly, soft factors also seem to play a large role beyond institutional structures. The **synthetic biology case** illustrates the positive role of a social network of scientists, while the **infrastructure case** demonstrates the negative consequences of a lack of “soft factors”. Examples of soft factors include the trustful communication among actors, which enables individual actors (including institutions) to adapt or revise management decisions in the light of new circumstances. A third soft factor that can be derived from the case studies is the necessity to think in a step-by-step mode and to avoid path-dependency.

8. The hallmarks and drivers of flexibility and adaptability

a) Continuous and independent efforts of close monitoring in conjunction with institutionalised feedback loops are crucial to ensure that new scientific, situational or other knowledge is identified, processed and conveyed to the decision-makers (DANMAP in Denmark: **AMR case**). In addition, organisations should enhance their learning programmes by simulating potential risks and disasters as a means to transfer the strategy or trial and error into the virtual world.

b) Monitoring should include changes in existing knowledge (new data), but also changes in the relevance and social relevance of knowledge (new meaning). For example, there may be a shift from reframing a bad habit (drinking, overweight, addiction to computer) to a publicly acknowledged illness for which insurances are required to provide compensation (**synthetic biology case**, where the definition of a risk is largely dependent on the social context and the social agreement on research purposes).

c) Management of risks needs to reconsider previous decisions and think about alternatives at each stage of the intervention process to avoid path-dependency (**infrastructure case**).

d) There is a need to create an institutional risk culture that provides a generic vision or narrative for all members of the organisation, independent of the specific rules and regulations (safety mindset). A dynamic risk culture needs to be adaptive to new context conditions but should provide coherence and continuity as means to create long-term identity (**AMR case**).

9. Communication

Communication lies at the heart of risk governance and is crucial in meeting all eight points of dealing with emerging threats. Communication needs to be tailored to the stage and phase within the risk governance cycle as well as to the risk and its context. Each situation requires robust and professionally designed strategies on how to communicate what to whom. For emerging risks it is also crucial to develop specific communication programmes for each envisioned intervention point in order to explain why actions are needed or inaction is warranted. Communication on risks is supposed to improve understanding of the risk and its context, to facilitate informed decisions about policies, to promote public preparedness and to build or maintain trust. Risk communication always needs to be tailored externally to stakeholders, the media, the public, and internally to other agencies, departments and regulatory bodies.

The IRGC risk governance framework includes specific guidelines for effective risk communication. For complex risks situations it is necessary to focus on scientific and expert models of the risk situation and to visualise them so that risk management decisions seem adequate in the eyes of the observers. If risks are characterised by a high degree of unresolved uncertainty, communication needs to address not only the technical data, scientific models and insights but also the issue of distribution and equity. Uncertainty means that there may be more risks than anticipated and those at risk are usually not the same individuals who reap the benefits. A third communication need arises if the risk-bearing activity is contested in society and risk and benefits are associated with conflicts and value differences. In this case of high political ambiguity, the IRGC framework advises risk communicators to include the broader context variables such as values, visions and worldviews into the communication as these elements trigger public perception and probably acceptance.

In spite of the crucial importance of risk communication, there is lack of systematic evaluations during as well as after a process. However, as much as monitoring and evaluation of the impacts of a pending threat are an essential part of prudent risk management so is monitoring and evaluation of risk communication. Intuition and personal experience cannot replace systematic studies about communication impacts. It is therefore advisable to involve communication experts and social scientists in the communication design from the beginning. Checking the scientific accuracy, ascertaining a balanced view on the pros and cons of risk management actions, sustaining a focus on decision-relevant information and evidence-based choices and organising communication feedback loops are all important tasks for the risk communication designers and evaluators. These tasks need to be done by using state-of-the art methods in social science and research.

Considering the eight points, the task of communication can be laid out as follows:

- **Transparency** Transparency itself is a communicative task, however the communicative aspect of transparency does also include communicating the rules and the intentions of communication to insiders and outsiders. One should make clear how transparency will be upheld in all stages what is communicated to whom, what might not be communicated for what reasons, and where the communication partners can get more detailed information.
- **Accountability** Who is accountable for what in the risk governance process has to be communicated; and even further, communication is part of being accountable. The practical implementation of internal and external communication is one indicator for relevant actors to judge whether accountability is being taken seriously.
- **Inclusion** Communication is the central part of any inclusion among private-public partnerships or among departments. Inclusion implies mutual communication. If stakeholders are invited to take part they need to know all the information available and should have access to all relevant documents.
- **Integration** Integration in whatever format is built on effective communication. It relies on the trust that each partner does not withhold relevant information and that new insights are shared as soon as they are available.

- **Evaluation of methods and strategies** The methods and procedures of the process need to be accepted by all involved or relevant actors. Even observers of a process need to understand and accept the methods and strategies applied in the process. Furthermore, it is essential to share the valuation results with partners and observers even if they are not favourable to the organisation or its objectives. Once withheld, trust is destroyed and evaluation results lose credibility.
- **Determining the right timing** It is obvious that decisions on the right timing need to be communicated to all relevant actors. Beyond this requirement communication itself must be timed. If a decision is not taken, it does not make sense to create a climate of speculation. Rather the communication should be about the process of decision-making and the options that are deliberated. Once a decision has been made, it is important to inform the directly affected groups before making it public. Communication success is often linked with a reasonable design of when to communicate what.
- **Prioritising risk issues** This is the most difficult task since one has to inform stakeholders and the public why specific risks (that may rank high in the public perception) are ignored or less intensely taken care of than assumed. There will always be advocates for putting priority on those risks that the organisation may find the least relevant. One way to avoid unnecessary tension is to include many stakeholders in the evaluation process so that a broad coalition evolves that carries more social weight and credibility than the organisation alone. Another way is to show the simulated consequences of each risk and to appeal to the common sense of the observers that those with high impacts need more attention than those with low impacts. In any case, the decision-making process on prioritisation should be communicated transparently to avoid impressions of “behind-closed-doors” decisions.
- **Ensuring flexibility and adaptability** Flexible responses and adaptable approaches are key to sound risk management. The risk governance process must be predictable and reliable, however at the same time open to new contexts and flexible to accommodate changed conditions. Ensuring flexibility and adaptability requires communication strategies that enable involved actors to remain involved without feeling overburdened through new risk management strategies. The risk of being labelled as arbitrary can only be overcome by clearly communicating what has been and will be changed for what reason.

Emerging risks in some cases can occur as a sudden crisis. Although in many ways risk communication and crisis communication are similar, there are important differences.

- Firstly, risk communication has more time available than crisis communication. Early indications of emerging risks are not as pronounced in the media as disasters; thus, in crisis communication there is no time to formulate a response, the response must be ready at hand before the crisis occurs.
- Secondly, in a crisis situation people react emotionally or – if they have experience of the disaster – by activating routines. Rarely do people panic, but in crisis situations they are not sensitive to complex explanations or guidelines. They want to know what to do and what not to do. In addition, they sense whether crisis managers care about them or not.
- Thirdly, there is often a large degree of confusion about the causes and the extent of the disaster, in particular directly after the event. In a crisis situation it is important for risk managers to admit that they do not have a complete picture of what is happening and that they are trying hard to resolve these uncertainties. In risk communication, uncertainty is an inadvertent companion of risk but nobody expects the uncertainty to be reduced or resolved in the immediate short term.

Thus, many the rules for effective communication differ between risk and crisis communication. This is why in this report the emphasis has been on emerging threats that have not yet manifested themselves and not on sudden disasters or crises. Both require prudent and anticipatory management skills as well as effective communication but they differ in context and public expectation.

Communication is a task that needs to be planned carefully in advance, designed to meet the requirements of each risk phase, adapted to reflect the risk context and thoroughly evaluated by systematic studies. Ad hoc communication is likely to fail and will generate negative consequences for the governance process even if the eight points are all well addressed. Communication is key to successful handling of risks in general, and emerging risks in particular.

9. The hallmarks and drivers of communication

- a) Communication needs to be tailored to the audience, the specific task of the governance process, and the characteristics of the risk itself (complexity, uncertainty, ambiguity).
- b) Risk communication is distinct from crisis communication in several ways, especially regarding time constraints and perceptibility of messages in situations of fear.
- c) Risk communication is never an ad hoc task. It needs to follow a thorough planning by communication experts, involving the planning of the communication, the designing of the messages, the adaption to the context (audience and risk context) and the evaluation of the communication.

Conclusion

Governments and government agencies need to be prepared for emerging risks, that is to say, for risks they do not have full knowledge about or even any knowledge. That situation cannot be solved by ad hoc approaches as too many variables intervene with each other, making the typical situation of a risk emergence a complex and sometimes also uncertain process regarding the expected outcome. In that situation, risk managers have to be prepared for the necessary steps, and even more so as usually a multitude of actors enters the stage, from within the organisation and from the outside. These actors have to be coordinated and, in some cases, involved to the appropriate degree.

To achieve the tasks in identifying and managing emerging risks, scenario building ahead of time can help to define the organisation's risk appetite, necessary intervention points, and trade-offs. If these elements become a part of an encompassing risk culture, an organisation will be well prepared to respond rather quickly to emerging risks. The response itself can be fertilised by the eight points discussed and analysed in this report, taking up the hallmarks and drivers in regard to each. With communication being an all-encompassing task, the eight dimensions guide the crucial issues to consider in dealing with emerging risks as a government agency.

In this context the case studies offered valuable insights in the implementation of the eight dimensions and showed rather different degrees of success. Outstanding in many respects is the AMR case, where a flexible structure was found that still offered enough structure and reliability, which included technical knowledge and societal values, and finally found tangible solutions for all involved actors. Similar results, although not to the same degree, can be found in the supply chains case study. Other cases, such as DNA and infrastructure, are in the context of either a new field of knowledge without a lot of experience (DNA) or are sketchy because of too many actors being involved and thus none showing adequate accountability (infrastructure case study). The third category of case studies (interaction, migration) suffers from a lack of integration, transparency, accountability and communication. There are either no structures, or the structures do not relate to the process as they should.

APPENDICES: Summary descriptions of the six case studies

Appendix 1: Synthetic biology case

Introduction to the case study on **Proactive and adaptive governance of emerging risks: the case of DNA synthesis and synthetic biology**

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“Synthetic biology is based on the transformation of biology brought about by the ability to determine the complete sequence of the DNA molecules that constitute an organism’s genome and on a parallel revolution in ability to synthesise sequences of DNA [...] The motivating goals of synthetic biologists [and the very promising advances in e.g. human health and environmental remediation] are [...] to use sets of genes to create novel engineered organisms with useful functions” There is much hope and high expectations that synthetic biology will help solve many of the current health and environmental challenges.

This case describes three specific risk situations, all related to the synthesis and release of pathogens which could cause serious damage. The risk could be involuntarily triggered but also voluntarily propagated by malicious motives.

a) The “DNA synthesis” case concerns synthesis and release of pathogens. It discusses the fact that “biosecurity regimes have been premised on the assumption that physical controls over access to pathogenic organisms would limit security risks”. In particular, “risks are now being governed by a [unique] mixture of public policies and private consortia”.

b) iGEM (International Genetically Engineered Machine) is an international student competition that has been “effective in promoting the diffusion of skills and in reducing the importance of tacit knowledge”. “This case discusses how safety and security risks that may emerge from educational activities are now being addressed through private voluntary action in cooperation with international and domestic authorities”.

c) The H5N1 case concerns inadvertent or deliberate release of pathogens with increased transmissibility. Two academic research projects modified H5N1 to facilitate mammal to mammal transmission. The case reviews debate over whether there is some “research that should not be conducted” and “results that should not be published”.

The new field of synthetic biology is governed by a mixture of legacy regimes, national framework guidance and transnational consortia. The soft social network of individuals involved in these governance processes ensures adaptability and flexibility. It is first the “track record” and behaviour of organisations or individuals who create those new organisms, which is scrutinised. In the absence (yet) of a mature technology, it is difficult to develop fixed and stable regulatory regimes. Cooperation between public and private sectors currently leads the thinking towards adaptive, prospective regulation and voluntary codes of conducts.

1. Creating transparency

Transparency varies from case to case in synthetic biology, with some actors noting security concerns, claiming trade secrets, invoking intellectual property rights and citing licensing provisions as justifications for limiting information access. As the focus of synthetic biology moves from academic actors to commercial firms, conflict over transparency will increase, as the public interest in open assessment of benefits and risks will collide with private interests in protection of intellectual property rights. In the context of synthesis screening, sharing information across firms in screening consortia is essential to effective screening. However, this information is sensitive. Private firms are reluctant to share information on the methods or findings of their private research. Intellectual property rights claims and licensing provisions may even be used to prevent some research by third parties on risk associated with synthetic biology.

2. Ascertaining accountability

Many of those generating potential risks in synthetic biology have been accepting responsibility for evaluating and managing the risks that they may be creating. Research funders in the United States including the National Science Foundation (NSF) and the Defense Advanced Research Projects Agency (DARPA) have accepted responsibility for identifying and addressing risks, in supporting independent safety and security review boards, in creating committees of experts reviewing emerging risks and ethical issues or in offering additional funding for work on safety and security.

Academic laboratories and commercial firms have a mixed record of acceptance of accountability. One exemplary case is the acceptance of accountability for risks associated with synthesis by major synthesis firms, albeit with fear of adverse publicity, fear of regulation, and fear of tort liabilities sharpening the interest of firms in addressing risks. Another exemplary case is the acceptance of accountability by some academic synthetic biologists. Not all synthetic biologists are interested in identifying and limiting risks. This may be due to the lack of positive professional rewards for scientists and engineers working to address accountability, the scarcity of funding and scepticism of colleagues. Positive incentives are needed to spur proactive risk engagement.

3. Fostering inclusion

Several events contributing to mutual distrust have contributed to polarisation and mutual isolation of civil society, biotechnology firms and academic synthetic biologists. In 2012, 111 environmental NGOs called for a moratorium on commercial applications of synthetic biology and the industry association backed away from engagement with NGOs. Some major international conferences and meetings limited participation of civil society and independent scientists and technologists. NGOs have criticised this for the potential for conflict of interest. However, in workshops conducted by the Wilson Center and NSF SynBERC under the Chatham House Rule, civil society, microbiologists, technologists and firms have continued to engage constructively in identifying risks and setting priorities for next stage research on risks.

4. Striving for integration

Cases in this paper are strong on enhancing integration between public and private sectors and among departments. Frameworks providing guidance on a voluntary basis have been developed in coordination with the state, private firms and international organisations and represent exemplary cases of effective public-private cooperation. The NSF SynBERC and Wilson Center based workshops on environmental risks and the Heidelberg biosecurity conference represent useful cases of substantial interdepartmental collaboration in risk identification and management. However, the synthetic biology cases treated environmental and security effects separately. To move deeply into risk management issues, organisers opted to focus on specific applications instead of treating synthetic biology as a generic category and opted to focus on concrete environmental and security effects instead of considering environmental, security, social, psychological and economic effects jointly.

5. Providing convincing methods

Cases treated in this paper provide examples or reasonably convincing methods and procedures for dealing with threats. Evaluation and monitoring is organised on an ad hoc basis with consortia of experts supporting scientifically and technically literate multi-stakeholder exercises on emerging risks associated with synthetic biology. These practices succeeded in identifying areas of agreement on risks and benefits, in flagging areas where uncertainty over risks precluded consensus and in tagging points where agreement would be difficult because of conflicts over values.

6. Prioritising risks

Prioritisation of synthetic biology risks is driven by the immediacy and potential severity of emerging threats, rather than long-term considerations. Near term security risks associated with the synthesis of pathogens by unknown actors and by research enhancing the virulence of pathogens have been treated as high priority risks. Near term environmental risks associated with academic research and industrial applications have not been treated as immediate and severe risks, but on case-by-case basis. Prioritisation is taking place within security and environmental domains, and not across domains or across impacts.

7. Time adjustment

In this case study, the question of timing is of crucial importance. The promulgation of damage can only be avoided if intervention is made early enough in the case of an emerging biological risk. Timing is also important in the scientific approval process to make sure solutions are designed before a crisis occurs. In a fast evolving field, it is crucial to seize technological opportunities when they become available. A public-private cooperation allows adequate timing of interventions.

8. Ensuring flexibility and adaptability

As an emerging technology, with considerable intrinsic uncertainty associated with applications, benefits and risks, synthetic biology is a strong candidate for adaptive approaches to risk management. Adaptive management of emerging risks requires active sensing, honest assessing and effective feedback to modify risk governance practices, and here a public-private hybrid system ensures high flexibility and adaptability. In a rapidly changing context, flexible mechanisms and adjustments are especially needed. In biosecurity, DNA synthesis screening appears to be an exemplary case of adaptive risk management, with continuous sensing, assessing and modifying of technologies, screening methods and operational definitions used by regulators and firms participating in the consortia. For environmental risks, with less immediate and clearly defines risks, the need for adaptive governance methods is even clearer.

9. Communication

There is a risk associated with “information creation and distribution”. As in the mousepox case, unexpected results create some debate over the disclosure of information that could actually lead to harmful consequences.

With regards to professionals involved in identifying, assessing and managing risks, competencies are brought together to include both risk governance processes and technical and scientific specialisations. In the exercises conducted at the Wilson Center, engineers, microbiologists, civil society and regulators were recruited for their diverse knowledge, and communication across domains was essential to a credible appraisal of risks.

Current research and issues raised above illustrate the following contributing factors:

- Scientific unknowns
- Loss of safety margins
- Varying susceptibility to the risk
- Conflicts about interests, values and science
- Social dynamics
- Technological advances
- Temporal complications
- Communication
- Information asymmetries
- Perverse incentives
- Malicious motives and acts

Appendix 2: Interaction case

Introduction to the case study on **Interaction of social and economic risk**

Darryl Jarvis, Johannes Loh, and Tim Hilger, Lee Kuan Yew School of Public Policy, National University of Singapore

The risks that this case considers are new emerging economic and social risks and the complexity of interdependencies between a greater variety of triggers and contributing factors. Economic risk can manifest in different ways, including high youth unemployment, chronic fiscal imbalances, large income disparity, increasing income inequality. Social risk can manifest in social immobility and limited access to education, water and food crises and unsustainable population growth; resulting in growing perceptions of social injustice.

Concern for risk is increasing because of the increasing interconnectedness between hazards and risk phenomena, with ripple effects within and across nation states, and because of the emerging role played by social media in propagating information. Many governments currently face great challenges in managing social and economic security, despite their willingness to be proactive in developing national and global structures that are capable of managing emerging risks. “The outcomes are often magnified through complex interaction of different types of risks, which increases the struggle of governments to find adequate responses” (p. 4).

“Governments have traditionally dealt with a great variety of different risks that imposed both operational and reputational threats. Risks from hostile countries, natural disasters, diseases and sickness fall in the category of traditional risks. Economic and social risks such as inflation, youth unemployment or perceptions of social injustice are not recent phenomena; however, a greater variety of triggers, contributing factors as well as scale and pace of emerging risks have caught special attention from governments” (p. 4).

New risks of economic and social desperation resulting from new trends such as price volatility in food and energy or loss of earning capacity, can amplify perceptions of injustice and dissatisfaction within parts of the society, challenging the government’s legitimacy. “If a government ultimately is unable to deal with these challenges it can escalate into a legitimacy crisis which would result in political and economic instability” (p. 5).

The case study is mainly illustrated by the case of Singapore, facing issues of economic and social disparities and growing demand for public participation. The case shows how economic risk can contribute to social risk. It also illustrates some features of economic and social risk interdependency with other examples in Asia, North Africa and the Middle East.

The more specific question considered in this case is whether a government can detect early signals of social and economic risks and develop economic and political scenario planning to design an appropriate risk management framework. It focuses on government policies and instruments to “shield individuals from harmful interactions between social and economic risks” (p. 5).

A list of indicators is suggested (appendix 2) to monitor suspected interactions of social and economic risks that may escalate to a critical threshold, and inform anticipatory policymaking. However, it is important to note that “specific critical thresholds depend on the respective cultural and societal context, as well as the government’s relative risk aversion” (p. 15).

1. Creating transparency

Transparency implies communicating information on emerging risk management to the public and parties concerned. Following the 2011 election, the Government of Singapore tried to react to criticism of a lack of public participation in engaging with social media to connect with the population. Within the Singapore Government, the establishment of Risk Assessment and Horizon Scanning (RAHS) and the Centre for Strategic Futures (CSF), as tools for coordinating various agencies, allows “faster exchange of information” and the promotion of a “culture of sharing relevant data” (p. 23).

2. Ascertaining accountability

Due to the interdependency of social-economic interactions, the question of accountability is critical. Decision-makers on the highest political levels are ultimately accountable for dealing with economic-social conflicts. In the whole-of-government approach presented in the Singapore case, the concept of risk ownership is central. Growing income inequality and perception of social injustice challenge the government's legitimacy and undermine public trust, which might, if not well managed, lead to tensions.

3. Fostering inclusion

Inclusive governance in this case is dependent on the specific risk management structure. The whole-of-government approach for example promotes inclusion of agencies and consolidation of various actors. Inclusion of third parties such as private sector or civil society is introduced progressively, for example with the Singapore National Conversation started in 2012.

4. Striving for integration

Looking at the specific case study of Singapore, but also considering other geographical and social areas, integration is crucial for adequate responses to highly interdependent social and economic risks. Social, cultural, economic and other factors need to be considered, and an analysis across sectors and across departments is essential. The Government of Singapore is promoting interagency government coordination to develop coherent and coordinated policies. The CSF proves that "cross-cutting function along various ministries [...] can make positive contribution to long-term policymaking" (p. 20).

5. Providing convincing methods

The case study points out that effective response to social and economic interactions should include the development of forecasting methods such as monitoring, modelling and scenario panning to allow management frameworks to capture emerging risks. However, this is a great challenge due to the volatility and unpredictability of these risks.

6. Prioritising risks

Prioritising risks in this case results from appropriate monitoring and modelling methods. The high degree of interdependence between contributing factors and the variety of impacts (from peaceful protests to riots or strikes, migration etc.) explain the difficulty to prioritise from the multitude of signals a government receives. The challenge remains in detecting early signals to develop an effective risk management framework, as well as exploring risks across sectors and agencies to achieve valid prioritisations.

7. Time adjustment

As mentioned above, detecting early signals is a challenge that governments should address. Determining intervention points is possible in developing critical thresholds for emerging economic and social risks. The government's ability to anticipate emerging risks at an early stage is decisive for adequate risk management.

8. Ensuring flexibility and adaptability

The flexibility and adaptability of risk management is dependent on the specific structure that is applied to manage the interactions between social and economic issues. The risk management framework in place determines the flexibility and adaptability of measures that are implemented.

9. Communication

As demonstrated by the Singapore case, greater integration among ministries and agencies results from strengthened information absorbing and processing tools, as well as inter-department exchange of information. An inter-departmental framework capable of dealing with cross-sectoral risk issues therefore requires communication at all stages of an integrative approach. In this specific case, communication with the public is still a challenge that needs to be addressed to restore trust.

The factors contributing to the risk are:

- Loss of safety margins (more interconnectedness between social/economic systems)
- Positive feedback (effect amplifies itself, i.e. social media reporting on social problems leads to more awareness of even more social problems)
- Varying susceptibility to the risk (less privileged groups are in most cases more vulnerable)
- Social dynamics
- Conflict of values, interests and science
- Communication
- Information asymmetries
- Malicious acts

Appendix 3: AMR case

Introduction to the case study on **Combatting the risk of antimicrobial resistance (AMR) in animals for the benefit of human health in Denmark**

Peter R. Wieling and Jørgen Schlundt, National Food Institute, Danish Technical University

This case study considers the food-borne antimicrobial resistance (AMR) risk, the resistance of certain bacteria strains against antibiotics used in animal feeding causing an increased risk for human health. It focuses specifically on the experience of Denmark. AMR developed as a result of the introduction of the use of antibiotics in veterinary medicine in the 1950s. Any use of antimicrobials in animal feeding can cause untreatable infections in humans.

In the 1950s and '60s antibiotics consumption increased for three purposes: 1) therapy of individual cases; 2) disease prevention for groups of animals; and 3) antibiotic growth promoters (AGPs). Since then, AGP have been intensively used, causing multi-resistant bacteria to develop.

Since 1995, Denmark has demonstrated the capacity to successfully reduce AMR, notably by banning the use of antibiotics in animal feeding (mainly avoparcin) and specifically the use of AGPs.

“In Denmark both the authorities and the farmers recognised the lack of knowledge about the transmission to humans, but they were also shocked by the steep increase in AMR caused by the use of AGPs in food production animals. Therefore, the Danish farmer organisations agreed to a voluntary withdrawal of the use of avoparcin in chickens. In addition, the Ministry of Food and Agriculture and the Ministry of Health initiated an integrated surveillance approach called DANMAP” (p. 9).

In order to overcome obstacles to the management of this emerging risk, a strong effort was made to cope with the lack of scientific knowledge in establishing the DANMAP programme (Danish Integrated Antimicrobial Resistance Monitoring and Research Programme). Its aim was principally to work collectively on how to address the problem, to use positive economic incentives and to communicate clearly with the public and all affected actors.

“The strength of the integrated approach of DANMAP was that it both integrated and separated different factors in the process of risk management. In addition, it made evidence-based decision-making possible which helped to bring together and convince all relevant stakeholders and ministries.” (p. 18).

1. Creating transparency

DANMAP's assessment results and management options and decisions were made public in reports available on the internet and produced to be understandable and readable to the public. This made the situation around AMR more transparent, and helped in filling the knowledge gaps. It also contributed to an easier implementation of risk management interventions broadly accepted. Transparency was further enhanced by the involvement of private actors in the risk assessment structure. The public, as well as environmental NGOs, were not directly involved in the process, but had access to all relevant information.

2. Ascertaining accountability

DANMAP's structure determined clearly who is accountable for what in separating risk assessment and risk management. Each actor in the DANMAP approach had their clear tasks and responsibilities. Further, through the transparent information given out to the public on DANMAP's work, accountability was always understandable to the public (at least accessible). The integration of relevant stakeholders and scientists also created a higher accountability.

3. Fostering inclusion

The Danish case is a very well developed example of inclusive governance. DANMAP has developed a “national cross-sector surveillance programme” in which the collaboration of various actors, including decision-makers, scientists and industry, offers a broad range of expertise. This inclusive approach enabled evidence-based decision-making.

4. Striving for integration

The Danish case-study displays a high degree of integration among different impacts and between departments. The risk AMR though AGP was still scientifically uncertain, however exactly because of this uncertainty and because of the potential impacts the risk could possibly have, the integration was a crucial way forward. The risk management process through DANMAP enabled the integration in all three domains: among impacts, among departments, and among private and public entities. Relevant private stakeholders were involved in a transparent way at an early point in time on issues that were widely communicated to the public. The collection of necessary scientific expertise was a fundamental pillar of this process.

5. Providing convincing methods

DANMAP used convincing methods and procedures to assess, evaluate, manage and communicate about the risk. Scientific evidence was integrated with social concerns of farmers. The separation of risk assessment and management is another important achievement of this case. Further, all actors were able to feed in data and to conduct or to re-analyze undertaken studies, which increased trust in the process. Those direct methods were coupled with guidance on more prudent use of antimicrobials.

6. Prioritising risks

As the risk identification in this case was the starting point of the risk management process, the prioritisation took place as part of the DANMAP process on specific aspects of the risk. Prioritisation of risk aspects was supported by the monitoring structure of DANMAP, which enabled decision-makers to adjust measures in light of new priorities.

7. Time adjustment

In this case, major risk management actions were taken at relevant time intervals, after a voluntary action based on judgements of involved actors. The Danish government banned the use of all avoparcin in late 1995, after a voluntarily stop of avoparcin use by farmers earlier that year. Danish legislation and guidelines to reduce the development of new AMR emerging risk are since then updated annually.

8. Ensuring flexibility and adaptability

DANMAP managed to create a structure in which risk assessment, risk management and also early warning and monitoring is integrated. Scientists from different disciplines worked together constantly, which offered intensive expertise and the monitoring of indicators from different perspectives. The inclusion of private stakeholders ensured that real-world early warnings are not overlooked but integrated as well. Through the different normative viewpoints of the involved actors, which all subscribed to the same institutional structure, flexibility and adaptability was ensured. The integration of different actors accountable for their tasks allows understanding and reacting to their specific needs. Further, the Danish approach showed flexibility to the risk assessment itself as a constant data collection took place from different sources. Thus, the monitoring was implemented with a high degree of commitment.

9. Communication

In DANMAP, communication was ensured throughout the risk management process, as all relevant stakeholders had access to relevant data. Communication was also important between scientist who could share their expertise and jointly analyse data. Reaching abroad audience encouraged transparency and helped to get a broad support to decision-making.

Factors contributing to the risk are:

- Scientific unknowns
- Loss of safety margins
- Positive feedback
- Varying susceptibility to the risk
- Conflicts about interests, values and science
- Social dynamics
- Technological advances
- Temporal complications
- Communication
- Information asymmetries
- Perverse incentives
- Malicious motives and acts

Appendix 4: Infrastructure case

Introduction to the case study on **Managing the risk of ageing infrastructure**

Richard G. Little, The Price School of Public Policy, University of Southern California

This case study addresses the risk of cascading failures of aging public infrastructures. It is illustrated by three infrastructure failures; the 2003 electrical blackout in the NE United States, the 2005 levee failures in New Orleans, and the 2011 Fukushima Daiichi nuclear power plant damage. In those three examples, 'the risk that failures could occur was overlooked or ignored', despite independent warnings.

There are several factors contributing to the emergence of the risk:

- a) The prevalence of perverse incentives where short-term economic and social goals are dominant over long-term safety objectives. "The incentive of measurable financial benefits from reduced safety precautions against an unmeasurable level of safety usually drives decision-making" (p. 3).
- b) The question of how to allocate scarce resources in order to reduce the effects of hazards and decrease the vulnerability to extreme events.
- c) Poorly understood ripple effects that stem from the interdependencies of infrastructures as well as from misallocation of resources. "In addition to a degradation of expected service levels, failures of ageing infrastructures also pose the risk of secondary, cascading effects which can have impacts far beyond a simple loss of service" (p. 2).
- d) Solutions designed after the occurrence of the problem focus on isolated events and not systemic problems, ignoring the underlying issues and allowing the failure to re-occur. However, "complex infrastructure systems are not inherently safe, no matter how well designed" (p. 3).

The risk has negative consequence for:

- The general public, which is directly affected by infrastructure failures and through loss of opportunity;
- Public institutions because of loss of investment and opportunity; and
- Other organisations, which are affected by the disruption of services due to an ageing/collapsing infrastructure.

The case stresses that "cascading infrastructures failures typically have common roots. These roots are not generally technological in nature and absent significant changes in organisational and regulatory mindsets are not readily amenable to improved engineering or other technical safeguards" (p. 2). Root causes of cascading failures are not technical in nature, but depend of institutional and human factors. "Major infrastructure failures [...] have their origins more in failures of institutions and governance than in engineering, construction and maintenance" (p. 13).

In summary, the case proposes to reset the objective in achieving safety rather than preventing failure. A new paradigm for effective management of emerging risks of failure of ageing critical infrastructure would imply to:

- Set positive incentives to invest in risk management;
- Build capacity to learn from experience; and
- Communicate (at the local level) to explain and share the benefits of effective risk management.

1. Creating transparency

In the regulation of complex technologies and infrastructure failures, information asymmetries are usually high and full disclosure into the public domain is often voluntarily neglected. Due to the lack of

a coherent governance approach for dealing with the ageing of public infrastructures, and considering the fact that involved actors prefer to avoid being accountable for the maintenance of public infrastructures, transparency is rather low. A coherent approach for communication is missing.

2. Ascertaining accountability

Accountability is in this context rather vague due to different legislative and executive levels of decision-making and resource distribution. Ageing of infrastructures is a risk to be dealt with by the infrastructure provider. However, it is often not clear whether that is for example the state or the federal government. Accountability is further difficult to determine as the high costs of building public infrastructure are often split between several sources, e.g. public departments or private entities. One major lesson learned is that accountability could be increased by regionalisation of decision-making power regarding public infrastructures and their maintenance.

3. Fostering inclusion

The case study of cascading failures of infrastructures demonstrated that most systems have not reached a situation of inclusive governance. Decisions on the maintenance of infrastructures are made on several levels, which are not connected to each other in a governance framework that would guide decision-making processes and risk management. Third party actors, such as civil society, are not included in the process. However, attempts to regionalise the decision-making processes seem promising in making decisions more transparent, accountable and also more inclusive at the local level.

4. Striving for integration

This case study points out a general lack of integration in the field of ageing infrastructures. Whereas there is usually a clear role assigned to those who build infrastructure, the question of maintenance and follow-up costs due to ageing is less prioritised. Resulting from that, there is less integration between departments and public and private entities, and more shifting of responsibilities from one department to the next. This also relates to the integration of impacts. Although there are approaches in which the integration of impacts are looked at scientifically, on the risk management level integration is rather low.

5. Providing convincing methods

The case study concludes that regarding the use of methods and procedures, the wrong questions are often asked. For example, instead of asking what has to be done to protect people in a certain area from flooding, it is rather asked (technically) how high the dam has to be. Thus, there is path-dependency for a purely technical outlook on the risk, rather than an integrative one. In terms of risk governance, that means that there is a focus on robustness, whereas a stronger emphasis on resilience would be desirable.

6. Prioritising risks

The lack of integration among departments and impacts aggravates risk prioritisation. As the technical risk is quite clear to a large degree, prioritising is about allocating and distributing resources to manage the risk. Without the integration of actors and impacts, distinguishing between serious threats from the background noise will remain difficult. Further, besides resources being wrongly distributed, the risk of ripple effect resulting from collapsing infrastructure is neither analysed nor prioritised.

7. Time adjustment

In the New Orleans case, “the institutional, financial, and technical conditions leading up to the levee failures took decades to coalesce. (...) The complacency that builds up when infrastructures do not fail, despite profound neglect, is a significant factor in the scale of the consequences when they do” (pp. 15–16).

As in the Fukushima Daiichi case, the historical record of tsunamis is scarce and lessons learned are often ignored. “Operational decision-making must occur in real-time in a very fast-moving system leaving little time to deal with unexpected problems” (p. 25). To overcome inertia, a new approach, encouraging safety measures over longer periods of time, is necessary.

8. Ensuring flexibility and adaptability

Flexibility and adaptability are dependent on a structure of risk management. However, as a multitude of institutions play a role in the management of ageing public infrastructures, flexibility and adaptability cannot be implemented to a desirable degree. Further, both flexibility and adaptability depend on the right questions being asked in the process (e.g. “what can go wrong?”, “what is the likelihood that it could go wrong?”, “what are the consequences of failure?”).

9. Communication

In the New Orleans case, coordination and cooperation were made very difficult after the failure due to communication outages. The population was mostly left with no communication about the on-going events or rescue operations.

In the Fukushima Daiichi failure, there was “little open and frank discussion of the risks of nuclear power, ways to mitigate the risks or emergency preparedness among the civilian population. Such discussion is incompatible with the myth of absolute safety.” (p. 23).

In the August 2003 in the Northeast power outage (USA), the deteriorating state of the system was not communicated to other related systems. Real-time information would have limited the scale and duration of the blackout.

Factors contributing to the risk are:

- Loss of safety margins
- Temporal complications
- Perverse incentives

Appendix 5: Food supply chains case

Introduction to the case study on **Risk governance of food supply chains**

Kees Burger and Jeroen Warner, Social Sciences Group, Wageningen University, the Netherlands

This case study considers:

- **Qualitative risks** in the food supply chain, i.e. mechanical qualities and food safety characteristics including health risks, “disturbances in these qualities may occur anywhere from original producers to final retailer and this necessitates coordination of information throughout the supply chain” (p. 5).
- **Quantitative risks** including disturbance in the flow of goods (causes lie mainly in developing countries, with consequences in developing and developed countries); and
- **Aggregated risks** which are sector-level risks emerging from individual companies’ behaviour with unintended consequences. “Individual firms take measures to prevent or to cope with a risk, and the aggregate of these measures affect their effectiveness” (p. 7).

More precisely, the risks are because:

a) Companies draw up business continuity plans to deal with the risks they anticipate, but these plans are not consistent with those of other companies as they:

- Call upon resources that other companies also use;
- Do not account for market failures invoking government interventions or these very interventions; and
- Do not account for changes in behaviour of firms, involving change in leadership roles.

b) Contingency plans for supply disruptions designed by the companies are incomplete.

c) Governments have no quantitative risk management plans that:

- Are consistent with companies’ plans;
- Incorporate firms’ behaviours; and
- Communicate with private sector actors.

“Disruptions in supply, typically caused by factors beyond control of the firms, may strike many firms that are not well prepared. Economic considerations induce them to sacrifice some resilience in favour of profits. Nodes in the supply system may prove weak points when disturbances occur. Large supply disruptions cannot be solved by the market and governmental intervention is likely to be called for.” (p. 7).

“When disruptions are relatively small, private chain members are normally well able to adjust in large disturbances however, solutions are often ill-coordinated and incite calls for state intervention as the risk absorber of last resort. Governments then emerge as ‘channel leaders’ or directors in supply chains, in both the harder (material) and softer (cultural, normative) sense.” (p. 14).

The risk develops as companies are encouraged to make contingency plans, and as companies become gradually more critical at various stages of the food supply chains. Despite the fact that private companies cannot engage in the process on their own, there is little incentive to discuss the plans with chain partners or the government, as the plans typically contain crucial strategic information that is internal to each company.

The suggestions made by the case for improving emerging risk from food supply chains include:

- Enhancing collaboration and coordinated actions; and
- Providing incentives to invest in robustness and resilience building.

Both dimensions call for more action or guidance from government/public sector agencies as drivers of private sector action and “supply chains coordination mechanisms”.

1. Creating transparency

For qualitative risks, transparency is assured by regulating authorities. For quantitative risks, transparency is the responsibility of private companies. As a consequence, contingency plans are internal or only transparent for the immediate partners. This limits the possibilities for consistent

contingency planning at higher levels (or discussion of these plans), including adequate responses from the government.

2. Ascertaining accountability

Food markets are under stricter national regulation, thus accountability relies on public actors in the first place. In European Union trade and elsewhere, firms are under increasingly stringent obligations to follow protocols to ensure sufficient levels of food safety. They are held accountable for this. This can be extended to the firms providing more scope for mitigation of supply disruptions.

3. Fostering inclusion

The food industry and its supply chains are traditionally closely linked among themselves and with governments in securing food quality. In this respect the process is rather inclusive. Over time, other qualities such as environmental and social qualities come into play, coinciding with increasing involvement of social organisations. In terms of quantitative risks, however, responsibility is in the hand of private firms who are less likely to implement an inclusive approach.

4. Striving for integration

Considering aspects of integration, there are well implemented networks of governments and firms to deal with qualitative risks in food supply chains (typically health related). Such coordination hardly exists for quantitative risks. Individual (large) firms secure their own supply and in this sense integrate with chain partners. When faced with major disruptions, however, individual contingency plans may fail, and integration with other firms and with the government can be required.

5. Providing convincing methods

Assuring quality standards for food safety is based on a set of regulations and scientific practices that are proven, convincing methods and procedures. Methods and procedures of communication and inclusion, however, are less structured and left to the actors involved.

6. Prioritising risks

The risk management system described in this case study has an emphasis on hazard handling. The quantitative or qualitative risks in supply chains have to be managed according to the procedures and regulations regardless of the risk itself. Food safety being a primary concern for all, governmental interventions are soon called for. This results in prioritisation often focusing on one aspect of the issue to achieve given objectives, neglecting other factors involved. An inventory of critical points (infrastructure, ICT, etc.) in the food supply system at large helps in prioritising safety measures.

7. Time adjustment

Food supply distributions can occur by surprise, requiring immediate action. To ensure scientific based decisions, investment in preparedness for timely interventions is necessary.

8. Ensuring flexibility and adaptability

The economics of the supply chains is such that spare capacity and redundancy add to the costs more than to the (short-term) revenues. Hence, flexibility is limited. This process is countered by the increasing scale at which firms operate, offering flexibility in allocation of flows within the firms. At the aggregate level, flexibility in case of calamities can be compromised by the degree of specialisation, increasing dependence on single points of infrastructure, single firms or single ingredients. While these large firms appear to embrace a risk management policy, a complementary policy at aggregate and governmental level, consistent with the firm level, is still not existent, nor is an appropriate authority to do so at the international level.

9. Communication

Governmental involvement is needed to ensure a holistic approach to risk management, involving supply chain coordination and risk management. This allows the exchange of information by the chain partners. In times of disruptions, communication of factual information is important. This also allows a coordinated flow of information to the public, which can help avoid reputation damage.

Factors contributing to the risk are:

- Scientific unknowns
- Loss of safety margins

- Positive feedback
- Varying susceptibility to risk
- Conflicts about interests
- Social dynamics
- Technological advances
- Temporal complications
- Communication
- Information asymmetries
- Perverse incentives
- Malicious motives and acts

Appendix 6: Migration case

Introduction to the case on **Migration as a policy response to population ageing**

George W. Leeson, Oxford Institute of Population Ageing, University of Oxford

The context of this case is set around migration to address risks related to population ageing. Migrant carers are needed to address provision of health and social care for older people in the UK. The risk is the potential inability of the private and public sectors to meet the future demand for health and social care of older people.

“The reliance on foreign born workers and the prospect of that reliance potentially increasing makes the need to address the sustainability of the workforce caring for older people even more acute.” (p. 15). “The other side of the issue [...] is whether the infrastructures in place to accommodate an eventual influx of relatively large numbers of migrant carers (as part of a conscious policy response or an unintentional labour force development) are adequate.” (p. 16).

Specific issues of concern include:

- How to attract and retain relevant social care workers. “The apparent mismatch between demand and supply in the care sector is related to the unfavourable employment and social conditions of jobs in the sector” (p. 5).
- That the capacity of foreign migrants may not be adapted to UK or old people needs. Attitudes and skills don’t match well. However, training and capacity building could remedy this in part.
- The need to consider influencing the demand for social workers, e.g. by incentivising families to look after their old people.
- That “the contribution which care workers are making to the care of older people is invisible to the majority of the public who are not in regular contact with the care system” (p. 17), and this may explain the communication issue.

1. Creating transparency

Transparency of the processes and decisions involved is dependent in this case study on the transparency of the regular policymaking mechanisms, comparable to the issue of accountability. The privatised work relations of migrant workers are only to a small degree transparent.

2. Ascertaining accountability

Due to the connection of different fields, i.e. immigration policies and social policies, as well as the implementation of social care facilities, accountability does not exist for one field alone. Government agencies and departments are accountable for immigration and social care policies, social care providers for the specific working conditions of migrant workers.

3. Fostering inclusion

Inclusive governance is low and actors are loosely connected. They react to decisions being made by other actors, with foreseeable decelerated reactions and effects in other areas.

4. Striving for integration

Integration plays a large role in this case study, and integration is achieved between government departments. A conscious organisational policy structure includes migration policies and health and social care. The need for workers explains the efforts made to achieve the intended consequences and to prevent unintended secondary impacts. The second kind of integration regarding impacts is less pronounced according to the case study. The integration of public and private partnerships shows a more ambivalent picture; on the one side the public-private institutions are very closely linked. Social care and migration policies are government’s responsibility and social care in most cases is implemented through private entities. On the other side the needs and requirements for employing migrant workers are often not sufficiently fed back to the government agencies.

5. Providing convincing methods

Convincing methods and processes are not straightforward. Besides the established regulatory processes of immigration and social care, new strategies for specialised recruitment are needed, rather than “recruitment campaigns focusing on target numbers” (p. 3).

6. Prioritising risks

Risk prioritisation does not take place in a defined process. Rather, prioritisation is defined by shortcomings, for example the lack of workers or concerns about language and communication skills. Those concerns are reacted upon in improving the training programmes for example.

7. Time adjustment

The question of timing is important as there is a risk balance to be addressed, “which arises from the increasing inability of the care sector to sustain its workforce without migrant cares on the one hand, and the concerns related to international migration on the other hand” (p. 6). Migration policies have to adjust rapidly to deal with the flow of migrant workers. A late policy adjustment would exercise pressure on recruitment of the care workforce.

8. Ensuring flexibility and adaptability

Flexibility and adaptability is rather low as the policies of immigration and social care are long-term policies within complex parliamentary processes. Thus, flexible responses to changing circumstances are rather difficult to accomplish. However, new strategies and programmes can be implemented at the departmental level.

Factors contributing to the risk are:

- Positive feedback
- Social dynamics
- Conflict about interests, values and science
- Temporal complications
- Communication
- Information asymmetries

Annex 1: Contributing factors to risk emergence

In the course of this report, reference is made to IRGC's report *The Emergence of Risks: Contributing Factors*². This report lists and describes 12 factors that can lead to risk emergence, amplification or attenuation and which are used in the case study analyses..

Scientific unknowns	Tractable and intractable unknowns contribute to risks being unanticipated, unnoticed, and over- or under-estimated.
System complexity	Some key characteristics of complex systems have the capacity to amplify the likelihood of a risk emerging or the severity of its consequences by increasing unpredictability (e.g., emergence), but some can also act as attenuators (e.g., self-organisation).
Conflicts of interest, values and contested science	Early risk management measures may be contested by interests who benefit from the emerging risk or who are threatened by risk identification and management. The opposing interests may contest the science or the values behind a risk management decision and public debates may not witness a clear separation between science and values.
Social dynamics	Risk may emerge when social dynamics change at a pace where institutions are not capable of maintaining enough stability for society to function in a fair, equitable, effective, and efficient manner.
Technological advances	Risk may emerge when technological change is not accompanied by scientific surveillance of the resulting public health, economic, ecological and societal impacts. Risks are further exacerbated when economic, policy or regulatory frameworks are insufficient, yet technological innovation may be unduly retarded if such frameworks are overly stringent.
Temporal complications	An emerging risk may be amplified if its time course makes detection difficult or if the time course does not align with the time horizons of concern to risk assessors and managers.
Communication	The severity of the consequences of an emerging risk may be amplified when communication about it is not appropriate. Over-communicating as much as under-communicating can generate excessive or insufficient fear, respectively, which creates gaps in the management of the risk.
Information asymmetries	Information asymmetries may be created intentionally or accidentally. In some cases, the maintenance of asymmetries can reduce risk, but in others, it can amplify risk, create mistrust and foster non-cooperative behaviours.
Perverse incentives	Perverse incentives may lead to the emergence of risks (either by fostering overly risk-prone behaviours or by discouraging risk prevention efforts).
Malicious attacks	Malicious motives give rise to emerging risks and risk profiles need to consider intentional as well as unintentional causes of risk. Malicious attacks are not new, but in a globalised world they can have much broader-reaching effects than in the past.

² Available here: http://irgc.org/wp-content/uploads/2012/04/irgc_ER_final_07jan_web.pdf

Annex 2: Ten basic requirements for improving collaboration between scientists and policymakers for issues involving scientific complexity and deep uncertainty

Emerging risk governance by the public sector requires close collaboration with scientists, who can analyse, hopefully in an objective and neutral manner, the many uncertainties about emerging threats, and acknowledgement of the role of experts who provide evidence-based information. However, the use of techniques to inform long-range strategic thinking about emerging risks imposes separate but complementary challenges for policymakers and for scientists.

Here are some guidelines developed in the course of IRGC project work on the interaction between science and policy. It is challenging for scientists to fully understand what policymakers need in order to be able to design effective policies, as well as for policymakers to fully understand what scientists need to provide in terms of knowledge that can be used in policy. It is worth investing in understanding how both communities work and in communication.

Five basic requirements for policymakers

1. Awareness

Handling risk – both opportunity and threat – is increasingly central to the business of government. The accelerating pace of change in science and technology, and the greater connectedness of the world, are creating new responsibilities and demands, and an expectation that governments will think more strategically about the short-, medium and long-term risks.

2. Risk ownership, incentives and reward

Governments need constantly to keep under review where responsibility for managing a particular emerging risk should best reside, as it is often difficult to identify who can or should “own” an emerging risk. Risk ownership, a term used to describe the fact that only those who have a personal stake in a risk will effectively deal with it, refers to creating links between cause and effect, between risk and reward. Some emerging issues offer opportunities as well as risks. By identifying a possible reward for those who decide to engage and spend money to mitigate an emerging risk (and who will get a return on their investment), the chances of successfully dealing with it will be higher, especially if policymakers establish political and business links between risk and opportunity, and communicate effectively about such opportunities.

3. Sound processes and systems

Successful risk handling rests on good judgment supported by sound processes and systems. Action is needed in systematic, explicit consideration of risk firmly embedded in government's core decision-making processes (covering policymaking, planning and delivery). Government should enhance its capacity to identify and handle strategic risks, with improved horizon scanning, resilience building, contingency planning and crisis management

4. Communication with stakeholder communities

A necessary condition for risk to be handled effectively is that those who hold the ultimate power must agree about the significance of the risk. In democratic societies, this often means that public perception holds the key. In societies with different power structures, the ultimate responsibility may lie in fewer hands. In any case, the key to effective action is first to persuade the power holders that the threat is real and that appropriate action is necessary and possible.

Open communication with stakeholders is especially important because policies for managing and coping with emerging issues often involve a trade-off between groups and individuals with different interests, and mitigation of a primary risk may create secondary risks. There can be a real moral hazard if the secondary risks are borne by vulnerable or less powerful members of a community, or by the members of an entirely different community. Addressing how such moral hazards might be handled is outside the scope of this report, but one suggestion for developing effective policies is to

look at how organisations (such as the insurance industry³) that habitually deal with this sort of risk manage such situations. In any case, emerging risks should be on the education agenda of all communities, from local to national and global level.

5. Collaboration

Today's administrative structures are based on a division of responsibility. Dealing successfully with emerging risks in any arena requires adopting a holistic approach that transcends traditional administrative boundaries. Methods to foster whole-of-government approaches to risk can be helpful in this regard⁴.

Five basic requirements for scientists and experts

1. Awareness

Scientists are encouraged to understand the potential for a risk-based approach to policymaking and how it differs from more traditional approaches. In particular, they must understand that the normal media-driven obsessions with the immediate past and the immediate future can co-exist in governments with longer term strategising in pursuit of legacy benefits for future generations. Policymakers are at least as interested in understanding the range of possibilities as they are in predictions of what the most probable outcome may be. They will increasingly prefer risk assessment to prediction, prefer impact assessment to estimates of probability, and prefer in any case to know what the harbingers of critical change are.

2. To look forward as well as back

"Those who cannot remember the past are condemned to repeat it." Santayana's well-known stricture could have been intended for emerging risks, where awareness of the possible consequences of change is an essential first step to dealing with the situation. Lack of awareness has often been a factor in the collapse of economies, societies and ecosystems – witness, for example, Gibbon's analysis of the collapse of the Roman Empire, and the many examples adduced by Malcolm Gladwell in *The Tipping Point* (2002) and by Jared Diamond in *Collapse: How Societies Choose to Fail or Succeed* (2005). Today, we can understand the real basis of such historic collapses ... and learn, not just from experience, but from concrete understanding and analysis. Awareness is the first, essential, step. But, in particular where human agencies are concerned, it is also true that past performance may not be a reliable indicator of the future. So an understanding of the history of the causes of a risk needs to be tempered by a willingness to consider what changes in the context may arise because of the increasing inter-connectedness of risks. The further ahead we need to look the more we need proven techniques of horizon scanning to estimate the range of possibilities that the future may hold.

3. Collaboration

Increasingly, the science of risk requires collaboration: within the scientific community where the science of complex adaptive networks has shown the need to adopt a holistic approach, just as governmental administrative structures based on a division of responsibility have demonstrated the weakness of "stove-piped" policy or strategy formulation. A cross-disciplinary approach is required despite the fact that such an approach is likely to be both difficult and challenging.

4. Avoid predictions (and baffling with science)

Empirical studies have shown that "science often becomes ammunition in partisan squabbling, mobilised selectively by contending sides to bolster their positions." Scientists themselves have sometimes contributed to this process by making claims at too early a stage in a research programme, and by naively appealing to the media, whose black-and-white agendas add further distortion.

³ See for example a World Bank Report, *Catastrophe Risk Financing in Developing Countries: Principles for public intervention* that stresses the need to control moral hazard in the design of efficient public catastrophe insurance programmes (<http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/CATRISKbook.pdf>) – see p. 78: "To prevent moral hazard, insurers strive to align the policyholder's interests with the overall interests of the insurance pool." In the case of new products, moral hazard is often linked to the lack of information: missing or uncertain information can give rise to moral hazards and lead to amplified losses.

http://media.swissre.com/documents/News_release_sigma_4_2011.pdf

⁴ For example, at the Centre for Strategic Futures of the Prime Minister's Office in Singapore: www.csf.sg

Scientists need to address this problem, both as individuals and as a group, and re-establish their authoritative, independent position in order to avoid the fate of the mythical Cassandra – that of making true predictions that were never believed until it was too late. In the field of risk assessment and management, and in particular given the uncertainties attaching to some emerging risks, scientists may prefer to avoid prediction at all. They should also avoid burdening with information policymakers who are already at risk of information overload. Above all, “everything should be made as simple as possible, but no simpler” (Albert Einstein).

5. Communication between scientists and policymakers

Politicians and other policymakers are liable to see scientists as just another pressure group. This conventional labelling undermines the community’s ability to contribute to understanding and dealing with emerging risks at a practical level. New ways, and new attitudes, must be found to establish genuine communication. The first step is for each all sides to understand and respect where the others are coming from. In particular, scientists must avoid over-claiming, and clearly identify any available short-term benefits of long-term policies.

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IRGC's reports and recommendations are developed as a result of projects including workshops at which experts contribute their knowledge and opinions. Thus, IRGC assures the scientific basis for its recommendations although these recommendations do not necessarily represent the views of all workshop participants, members of a project's leadership team or their employers.

For this project, IRGC invited a number of individuals with expert and practitioner knowledge in the field of risk management in central government, in charge of developing risk governance frameworks or guidelines for ministries or public sector agencies. They met at a first workshop in March 2012. The countries represented were Canada, the Netherlands, Singapore, Switzerland and the UK.

A preliminary version of this report was proposed for discussion at a second workshop organised in September 2012 with the same representatives as well as:

Authors of the case studies: Jørgen Schlundt (National Food Institute, Technical University of Denmark), Jeroen Warner (Social Sciences Group, Wageningen University), Richard G. Little (Price School of Public Policy, University of Southern California), Todd Kuiken (Science and Technology Innovation Program, Woodrow Wilson Centre for Scholars) and George Leeson (Oxford Institute of Population Ageing, University of Oxford) and Tim Hilger (Lee Kuan Yew School of Public Policy, National University of Singapore).

Other external experts, selected for their experience in risk governance, who made presentations about recommendations for emerging risk management in government: Simon Pollard (Department of Environmental Science and Technology, Cranfield University), Mathieu Trépanier (Tsquared Consulting Partners Inc.), Marc Saner (Institute for Science, Society and Policy, University of Ottawa), Leena Ilmola (International Institute for Applied Systems Analysis, IIASA), Pierre-Alain Schieb (OECD International Futures Programme), Wändi Bruine de Bruin (Centre for Decision Research, Leeds University Business School).

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About IRGC

The International Risk Governance Council (IRGC) is a non-profit and independent foundation whose purpose is to help improve the understanding and governance of systemic risks that have impacts on human health and safety, on the environment, on the economy and on society at large. IRGC's mission includes developing concepts of risk governance, anticipating major risk issues, and providing risk governance policy advice for key decision-makers. To ensure the objectivity of its governance recommendations, IRGC draws upon international scientific knowledge and expertise from both the public and private sectors in order to develop fact-based risk governance recommendations for policymakers. IRGC operates as an independent think-tank with multidisciplinary expertise and can help bridge the gaps between science, technological development, policymakers and the public. IRGC acts as a catalyst for improvements in the design and implementation of risk governance strategies that can be effective in today's challenging governance environment.

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